MATHER AFB
CALIFORNIA

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 467610

Performance-Based Remediation
Former Mather Air Force Base

Fourth Five-Year Review Report

FINAL

August 2015

U.S. AIR FORCE

URS

DEPARTMENT OF THE AIR FORCE
AIR FORCE CIVIL ENGINEER CENTER

SEP 30 2015

MEMORANDUM FOR SEE DISTRIBUTION

FROM: AFCEC/CIBW
3411 Olson Drive
McClellan, CA 95652-1003

SUBJECT: Signature Page and Compact Disk for the Fourth Five-Year Review Report for former Mather Air Force Base (AFB)

The September 2015 Fourth Five-Year Review Report for Mather AFB has been signed by the Air Force. Those who received a hard copy and CD in the previous distribution are receiving a hard copy of the signature page and a CD containing the complete report. Please insert the signature page into the report in place of unsigned page 9-2. Those of you who received a CD are receiving a replacement CD containing the complete report.

The signed Final Fourth Five-Year Review Report for the former Mather Air Force Base (Mather) has been posted at https://ftpmccln.gtntechsol.com/home/ftpViewer?tag=/Mather. If requested, username: mcclellan, password: mcclellanAFB1. The report is in pdf format.

Please address any questions to me at (916) 643-6420, ext. 202, or to Bill Hughes, CNTS, at (916) 997-1564.

DOUGLAS L. SELF
BRAC Environmental Coordinator

Attachments:
1. Hard copy of completed signature page
2. CD of signed Final Fourth Five-Year Review Report for Mather AFB

DISTRIBUTION:
AFCEC/CIBW-McClellan, Attn: Administrative Record File (hard copy + CD)
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AFCEC/CIBW-Lackland, Attn: Stanley Pehl (CD only)
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URS, Attn: Paul Graff (CD only)
U.S. EPA Region IX, Attn: John Lucey (CD only)

URS

18600771.35001
30 September 2015

Mr. Stanley Pehl
AFCEC/CIBW
2261 Hughes Avenue, Suite 155
Joint Base San Antonio, Lackland, TX 78236-9853

Subject: Final Fourth Five-Year Review Report Signed Signature Page, Compact Disc
Contract FA4890-06-D-0006, Task Order 0007
Former Mather Air Force Base (Mather), California

Dear Mr. Pehl:

URS Group, Inc. is submitting the signature page signed by the Air Force for the final *Fourth Five-Year Review Report* for the former Mather Air Force Base (Mather), California. The unsigned report was issued on 31 August 2015. The attached signature page replaces the unsigned page in Section 9.0 of the report (page 9-2). The attached compact disc contains the entire report with the signed signature page. This document will also be posted at https://ftpmccln.gtntechsol.com/home/ftpViewer?tag=/Mather. If requested, username: mcclellan, password: mcclellanAFB1. The report is in pdf format.

If you have any questions or comments, please contact me at (916) 643-1818.

Sincerely,

Paul Graff

Paul Graff, P.G.
Project Manager

PG/gng

Attachment:
Fourth Five-Year Review Report Signed Signature Page (p.9-2), Compact Disc

c: See distribution list, AFCEC/CIBW cover letter
https://afcee-eim.brooks.af.mil/Projects/PM/DZ
URS Project File (18600771.35001)

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18600771.35001

FINAL

FOURTH FIVE-YEAR REVIEW REPORT

FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

Prepared for:

AFCEC/CIBW
Stanley Pehl
2261 Hughes Avenue, Suite 155
Joint Base San Antonio-Lackland, Texas 78236-9853

In Support of:

AFCEC/CIBW
3411 Olson Street
McClellan CA 95652

Prepared by:

URS Group, Inc.
2870 Gateway Oaks Drive, Suite 150
Sacramento, California 95833

August 2015

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LIST OF ABBREVIATIONS AND ACRONYMS

AC&W	Aircraft Control and Warning
ACL	aquifer cleanup level
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCEC	Air Force Civil Engineer Center
AFRPA	Air Force Real Property Agency
AGE	aerospace ground equipment
Air Force	United States Air Force
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
ATC	Air Training Command
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
BV	bioventing
Cal Am	California American Water Company
Cal/EPA	California Environmental Protection Agency
CalRecycle	California Department of Resources Recycling and Recovery
CBRA	comprehensive baseline risk assessment
CCR	California Code of Regulations
CCl_4	carbon tetrachloride
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfm	cubic feet per minute
CHHSL	California human health screening level
COC	contaminant of concern
Contingency Plan	Mather AFB Off-Base Water Supply Contingency Plan
CVWB	Central Valley (Regional) Water (Quality Control) Board
cy	cubic yard
CZA	capture zone analysis
DCA	dichloroethane
DCE	dichloroethene
DD	drainage ditch (IRP site designation)
DoD	Department of Defense
DOI	United States Department of the Interior
DPE	dual-phase extraction
DTSC	California Department of Toxic Substances Control
EA Engineering	EA Engineering, Science, and Technology
EPA	United States Environmental Protection Agency
ESD	explanation of significant difference(s)
FAA	Federal Aviation Administration
FFA	Federal Facility Agreement
FFS	focused feasibility study
FS	feasibility study
FT	fire training (IRP site designation)

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

GAC	granular activated carbon
GCLE	groundwater cleanup level equivalent
gpm	gallons per minute
Granite	Granite Construction Company
GWMPER	Groundwater Monitoring Program Evaluation Report
HSG	hydrostratigraphic
IC	institutional control
ID	identification
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
JP-4	jet propellant fuel #4
lb/day	pounds per day
LF	landfill (IRP site designation)
LMT	Laguna-Mehrten Transition
Mather	the former Mather Air Force Base
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MMRP	Military Munitions Response Program
msl	mean sea level
MWH	Montgomery Watson Harza Americas, Inc.
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
OEHHA	Office of Environmental Health Hazard Assessment
O&M	operations and maintenance
OPS	operating properly and successfully
OT	other (IRP site designation)
OU	Operable Unit
OWS	oil-water separator
PAH	polycyclic aromatic hydrocarbon
PCE	perchloroethene (a.k.a. tetrachloroethene)
PFC	perfluorinated compound
PFOS	perfluorooctane sulfonate
PHG	public health goal
POL	petroleum, oil, and lubricant
ppmv	parts per million by volume

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

RAB	Restoration Advisory Board
RAO	remedial action objective
RAR	remedial action report
RI	remedial investigation
ROC	reactive organic compound
ROD	record of decision
RPM	remedial project manager
RSL	regional screening level
RW	radioactive waste (IRP site designation)
SAC	Strategic Air Command
scfm	standard cubic feet per minute
SCWA	Sacramento County Water Agency
SD	storm drain (IRP site designation)
SLUC	state land use covenant
SMAQMD	Sacramento Metropolitan Air Quality Management District
SNARL	suggested no-adverse-response level
SS	sanitary sewer (IRP site designation)
ST	storage tank (IRP site designation)
SVE	soil vapor extraction
SVMP	soil vapor monitoring point
TBC	to be considered
TCE	trichloroethene
Teichert	Teichert Aggregates Company or Teichert Land Company
TPH	total petroleum hydrocarbons
TPH-d	total petroleum hydrocarbons reported as diesel
TPH-g	total petroleum hydrocarbons reported as gasoline
UCL	upper confidence limit
URS	URS Group, Inc .
UST	underground storage tank
VOC	volatile organic compound
WP	waste pit (IRP site designation)
μg/L	micrograms per liter
§	Section
4Q13	fourth quarter 2013 (quarter, year)

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Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Mather Air Force Base		
EPA ID: CA8570024143		
Region: 9	**State:** CA	**City/County:** Rancho Cordova (partially)/Sacramento
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** US Air Force		
Author name (Federal or State Project Manager): Douglas Self		
Author affiliation: AFCEC/CIBW		
Review period: 10 March 2014 – 30 September 2015		
Date of site inspection: 10 March 2014		
Type of review: Statutory		
Review number: 4		
Triggering action date: 30 September 2010		
Due date *(five years after triggering action date)*: 30 September 2015		

Five-Year Review Summary Form (continued)

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
AC&W Plume (OU 1), Landfill OU (OU 4), Basewide OU (OU 5), Supplemental Basewide OU (OU 6)

Issues and Recommendations Identified in the Five-Year Review:

OU: 2 – Groundwater – Main Base/SAC Area and Site 7 Plumes	**Issue Category: Changed Site Conditions**			
	Issue: Influent and effluent samples collected from the Main Base/SAC Area and Site 7 groundwater treatment plants contained concentrations of perfluorinated compounds (PFCs). One sample, from the Main Base/SAC Area plant, contained concentrations of perfluorooctane sulfonate (PFOS) at concentrations slightly greater than EPA's Provisional Health Advisory Level.			
	Recommendation: Conduct follow-up groundwater sampling for PFC analysis in the Main Base/SAC Area and Site 7 plumes.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Unknown	Federal Facility	EPA/State	9/1/2020

OU: 3 – Soil – Site SD-59	**Issue Category: Institutional Controls**			
	Issue: TCE concentrations in the new shallow vadose zone wells southeast of the site and outside of the IC area may pose an unacceptable threat to human health via the vapor intrusion pathway.			
	Recommendation: Further assess the extent of VOCs near Building 4260, possibly designating a new site, and expand the IC boundary to the south and east via an appropriate decision document.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	12/31/2016

Protectiveness Statement(s)

Operable Unit: OU 1 – AC&W, Site WP-12	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* Click here to enter date.
Protectiveness Statement: The remedy at OU 1 (AC&W OU) is protective of human health and the environment.		

Operable Unit: OU 2 – Groundwater, Main Base/SAC Area Plume, Northeast Plume, Site 7 Plume	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* Click here to enter date.
Protectiveness Statement: The remedies at OU 2 (Groundwater OU) are protective of human health and the environment in the short term due to already existing ICs. For the remedy to be protective in the long-term, the following actions need to be taken: the presence and magnitude of PFCs in groundwater must be determined; potential risks from exposure to PFCs must be evaluated; and appropriate remedies (if any) must be determined and documented in appropriate decision documents.		

Operable Unit: OU 3 – Soil, Sites WP-07, FT-11, ST-37, ST-39, SS-54, SD-57, SD-59, OT-69	*Protectiveness Determination:* Short-term Protective	*Addendum Due Date (if applicable):* Click here to enter date.
The remedies at OU 3 (Soil OU) are protective of human health and the environment in the short term. However, for the Soil OU remedies to be protective in the long term, the IC boundary at Site SD-59 needs to be expanded to the south and east to address the potential risk to human health from the vapor intrusion pathway. Investigation and risk assessment activities are also needed at Building 4260, where a new source area may have been discovered.		

Operable Unit: OU 4 – Landfill, Sites LF-03, LF-04	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* Click here to enter date.
Protectiveness Statement: The remedies at OU 4 (Landfill OU) are protective of human health and the environment.		

Operable Unit: OU 5 – Basewide, Sites FT-10C, LF-18, OT-23, ST-68, OT-87	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* Click here to enter date.

Protectiveness Statement: The remedies at OU 5 (Basewide OU) are protective of human health and the environment.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU 6 – Supplemental, Site OT-89	Protective	Click here to enter date.
Protectiveness Statement: The remedy at OU 6 (Supplemental Basewide OU) is protective of human health and the environment.		

Sitewide Protectiveness Statement (if applicable)	
Protectiveness Determination: Short-term Protective	*Addendum Due Date (if applicable):* Click here to enter date.
Protectiveness Statement: The remedial actions at Mather AFB are short-term protective of human health and the environment. For the remedies to be protective in the long term, the IC boundary at Site SD-59 needs to be expanded to the south and east to address the potential risk to human health from the vapor intrusion pathway and additional investigation and risk assessment activities are needed at Building 4260 (which may be a new site). For groundwater, presence and magnitude of PFCs in groundwater must be determined; potential risks from exposure to PFCs must be evaluated; and appropriate remedies (if any) must be determined and documented in appropriate decision documents.	

EXECUTIVE SUMMARY

This five-year review evaluates the environmental cleanup remedies at the former Mather Air Force Base (Mather) in California, to determine if the remedies are protective of human health and the environment. This five-year review has determined that all of the remedies are protective in the short term, and that most are protective in the long term. For three sites, (the Main Base/SAC Area plume, the Site 7 Plume, and Site SD-59) the determination of long-term protectiveness has been deferred pending the results of additional sample collection.

Mather AFB, originally called Mather Field, is located on approximately 5,717 acres which are partially in unincorporated Sacramento County and partially in the city of Rancho Cordova, California. The Air Force Base was first activated in 1918 as a combat pilot training school and operated intermittently until the start of World War II. After World War II, Mather AFB was the sole aerial navigation school for the United States military and its allies. On 30 September 1993, the base was decommissioned under the Base Realignment and Closure Act. Since its closure, the former base has been in transition to civilian use, and by the end of 2013, transfer of nearly all of the Air Force property was complete. The remaining portions of two parcels are planned for transfer by the Department of the Interior to Sacramento County. About one-half of the base is now used as a cargo-focused and general aviation airport, and about one-third is used as parkland, including an 18-hole golf course. The former military housing has been replaced by larger, single-family homes. Much of the rest of Mather has been transferred or sold for business development and government use. Land uses at Mather include a National Guard station, a Veterans Affairs hospital, two FAA radar facilities, two churches, and two elementary schools.

To perform its mission, Mather's military workforce used chemicals, including fuels, solvents and oils. Over the years while the base was open, some chemicals leaked into the ground from storage tanks. Some were washed down drains or spilled during transportation and use. Chemical disposal also contributed to soil and groundwater contamination. Such disposal practices, legal in the past, are now known to cause environmental contamination and are no longer used.

In 1979, contamination was detected in water supply wells near Mather. The primary source was solvents such as tetrachloroethene (PCE), trichloroethene (TCE), and carbon tetrachloride (CCl_4). More extensive testing followed in the 1980s, and 89 sites were identified as needing further study or cleanup, as well as four areas of groundwater contamination. Part of Mather was added to the United States Environmental Protection Agency’s (EPA) National Priorities List in July of 1987, and the remainder was added in June of 1989. Adding Mather to the NPL ensures that many parties are involved in the cleanup effort, including EPA, the California Department of Toxic Substances Control and the Regional Water Quality Control Board. The Air Force is financially and legally responsible for the cleanup to protect human health and the environment.

The 89 Mather IRP sites have been grouped into six Operable Units (OUs), based on similarities in contaminants, affected media, and/or timing of cleanup decisions.

- OU 1 (referred to as the Aircraft Control and Warning, or AC&W OU) consists of a contaminated groundwater plume, as well as three sites where underground storage tanks (USTs) were removed.
- OU 2 (referred to as the Groundwater OU) consists of three other contaminated groundwater plumes.
- OU 3 (referred to as the Soil OU) comprises contaminated soil associated with waste disposal pits, oil-water separators (OWS), gas stations, USTs, fire training areas, and other contaminated soil sites.
- OU 4 (referred to as the Landfill OU) consists of six sites where municipal waste was buried.

- OUs 5 and 6 (referred to as the Basewide OU and Supplemental Basewide OU, respectively) consist of the contaminated soil sites not included in other OUs.

This is the fourth five-year review report for remedial actions performed at Mather. This five-year review has been prepared pursuant to the Records of Decision (RODs) for OUs 1 through 6, as modified by one memorandum of post-ROD changes and eight explanations of significant difference(s) (ESD). All of the OUs were evaluated. The triggering action for this review is the date of EPA's concurrence on the third five-year review, which was 30 September 2010.

This Executive Summary focuses on the remedies that have protectiveness issues. For more information about the entire remediation program at Mather, the reader is encouraged to review the entire document.

Protectiveness Determinations

The purpose of a five-year review is to evaluate the implementation and performance of the remedies, to determine if they are or will be protective of human health and the environment. The process used to review each OU is consistent with the 2001 EPA Comprehensive Five-Year Review Guidance (EPA, 2001). That guidance document outlines a process that is used to assess the protectiveness of the remedy as well as involve the community during the five-year review. In order to assess the protectiveness of the remedy, site inspections, along with document and data review are necessary. Three questions examined during the technical assessment of a remedy are:

A. Is the remedy functioning as intended by the decision documents?
B. Are the assumptions used at the time of remedy selection valid?
C. Has any other information been identified that could call into question the protectiveness of the remedy?

The outcome of each five-year review is a statement of protectiveness as well as a list of issues, recommendations, and follow-up actions for each OU.

Operable Units with Issues

This five-year review evaluates the remedies in all of the OUs at Mather, using data collected from January 2009 through September 2014. These data include data reported and evaluated in the monthly, quarterly, semiannual, and/or annual progress monitoring reports, which are cited throughout this document, where appropriate. More recent data and analyses (through November 2014) are also included for some sites.

All of the remedies and OUs are protective of human health and the environment, at least in the short term. The groundwater extraction and treatment systems are operating properly and successfully; soil vapor extraction and/or bioventing systems are operating or, at some sites, have completed the remediation; and the post-closure landfill monitoring is ongoing. Institutional controls are in place to prevent human exposure to contaminants.

This fourth five-year review identifies two issues that need to be addressed:

- Emerging chemicals known as perfluorinated compounds (PFCs). These compounds had not been identified as chemicals of potential concern at the time of the records of decision, but have "emerged" as chemicals in the environment that present real or potential unacceptable human health or environmental risks.

- A possible new TCE source with potential indoor air exposure issues at Site SD-59.

These issues are discussed more, below, and in the body of the document.

The following table summarizes the OUs and the protectiveness determinations made in this five-year review.

Table ES-1. Operable Units Evaluated in this Five-Year Review

OU	Other Federal Agency Name	Description	Contaminant Types	Remedial Action Objectives	Remedy	Remedy Status
OUs That Are Protective in the Short Term/Long-Term Protectiveness Deferred						
2	Groundwater	Note: For OU 2, the Main Base/SAC Area Plume and Site 7 Plume require additional information for long-term protectiveness determination; the Northeast Plume is determined to be protective in the long term.				
		Main Base Plume/SAC Area Plume	VOCs, TPH, lead	• Achieve the ACLs throughout the contaminated aquifer • Comply with the discharge standards for disposing of the treated water • Land-use restrictions on Air Force property, as appropriate • Groundwater monitoring For ICs: • Prevent human exposure to groundwater with contaminants at concentrations exceeding the cleanup levels specified in the Groundwater OU ROD or 2010 Groundwater OU ROD ESD • Protect integrity of remedial action and remedial system, including the monitoring system • Protect integrity of remedial action and remedial system, including the monitoring system	• Groundwater extraction, treatment, and discharge • ICs in the form of land-use restrictions in deeds and state land-use covenants with property transfer	• Operating properly and successfully • Evaluation of long-term protectiveness is deferred until more sampling data are available for PFCs
		Site 7 Plume	VOCs, TPH	• Achieve the ACLs throughout the contaminated aquifer • Comply with the discharge standards for disposing of the treated water • Land-use restrictions on Air Force property, as appropriate • Groundwater monitoring	• Groundwater extraction, treatment, and discharge • ICs in the form of land-use restrictions in deeds and state land-use covenants with property transfer	• Operating properly and successfully • Evaluation of long-term protectiveness is deferred until more sampling data are available for PFCs

Table ES-1. (Continued)

OU	Other Federal Agency Name	Description	Contaminant Types	Remedial Action Objectives	Remedy	Remedy Status
OUs That Are Protective in the Short Term/Long-Term Protectiveness Deferred (cont'd)						
2 (cont'd)	Groundwater (cont'd)	Site 7 Plume (cont'd)	VOCs, TPH, lead	For ICs: • Prevent human exposure to groundwater with contaminants at concentrations exceeding the cleanup levels specified in the Groundwater OU ROD or 2010 Groundwater OU ROD ESD • Protect integrity of remedial system, including the monitoring system • Protect necessary access to remedial and monitoring systems		
		Northeast Plume	VOCs	• Protect the public from inadvertent significant exposure to contaminated groundwater For ICs: • Prevent human exposure to groundwater with contaminants at concentrations exceeding the cleanup levels specified in the Groundwater OU ROD or 2010 Groundwater OU ROD ESD • Protect integrity of remedial system, including the monitoring system • Protect necessary access to remedial and monitoring systems	• Long-term groundwater monitoring • ICs in the form of land-use use restrictions in deeds and state land-use covenants with property transfer	Operating properly and successfully

Table ES-1. (Continued)

OU	Other Federal Agency Name	Description	Contaminant Types	Remedial Action Objectives	Remedy	Remedy Status
OUs That Are Protective in the Short Term/Long-Term Protectiveness Deferred (cont'd)						
3	Soil	Note: For OU 3, Site SD-59 requires additional information for a long-term protectiveness determination; the other OU 3 sites are determined to be protective in the long term.				
		WP-07/FT-11	TPH	• Achieve cleanup standards for COCs • Mitigate any residual source of groundwater contamination that may be present • Comply with ARARs for the Site WP-07 solid waste disposal site For the ICs: • Protect the integrity of the soil remedial actions and systems, including monitoring systems • Preserve access to the site, the remedial systems, and associated monitoring systems	• Fill the depression at Site WP-07 • Treatment of the contaminated shallow and deep soils by BV and possibly SVE • Installation of an engineered cap • Land-use restrictions to protect the landfill cover at Site WP-07 • ICs	• In situ treatment (SVE and bioventing) complete • Landfill remedy ongoing • Operating properly and successfully • Operating properly and successfully
		Sites ST-37/ ST-39/ SS-54	TPH, and benzene, toluene, ethylbenzene, and total xylenes	• Achieve cleanup standards for COCs • Mitigate any potential or residual source of groundwater contamination For ICs: • Prevent unacceptable human exposure to soil vapor or residual contamination • Protect integrity of remedial system, including the monitoring system • Protect necessary access to remedial and monitoring systems	• Excavation • Ex situ treatment of soil by bioremediation • In situ treatment of contaminated shallow and deep soils by BV and possibly SVE • ICs	• Operating properly and successfully

Table ES-1. (Continued)

OU	Other Federal Agency Name	Description	Contaminant Types	Remedial Action Objectives	Remedy	Remedy Status
OUs That Are Protective in the Short Term/Long-Term Protectiveness Deferred (cont'd)						
3 (cont'd)	Soil (cont'd)	SD-57	TCE	• Achieve cleanup standards for COCs • Mitigate any potential or residual source of groundwater contamination that may be present For ICs: • Prevent unacceptable human exposure to soil vapor or residual contamination • Protect integrity of remedial system, including the monitoring system • Protect necessary access to remedial and monitoring systems	• SVE • ICs	• Operating properly and successfully
		SD-59	TPH	• Achieve cleanup standards for COCs • Mitigate any potential or residual source of groundwater contamination that may be present For ICs: • Prevent unacceptable human exposure to soil vapor or residual contamination • Protect integrity of remedial system, including the monitoring system • Protect necessary access to remedial and monitoring systems	• Excavation • Ex situ treatment of soil by bioremediation • SVE/BV to treat residual contamination • ICs	• Operating properly and successfully • Possible new source area identified near Building 4260, outside the current IC boundary. Investigation to be completed, along with an assessment of a possible excessive indoor air exposure risk at Building 4260.

Table ES-1. (Continued)

OU	Other Federal Agency Name	Description	Contaminant Types	Remedial Action Objectives	Remedy	Remedy Status
OUs That Are Protective						
1	AC&W	WP-12	TCE	• Remove contaminant mass from groundwater and remediate the plume to 5 µg/L for TCE • Comply with discharge standards for disposal of treated water • Comply with air emission requirements For ICs: • Prevent human exposure to groundwater with TCE > 5 µg/L • Protect integrity of remedial system, including the monitoring system • Protect necessary access to remedial and monitoring systems	• Groundwater extraction, treatment, and discharge • ICs	• Operating properly and successfully
		ST-25, ST-30, and ST-47				Remedy complete
4	Landfill	LF-02, LF-05, and LF-06	POL, VOCs	NA	Excavation of wastes and disposal to LF-04	Remedy complete
		LF-03	Landfill wastes	• Close the landfill in compliance with ARARs and, thereby, protect human health and the environment	• Engineered cap • Groundwater and landfill gas monitoring • Access restrictions • ICs	Remedy in place; operating properly and successfully
		LF-04	Landfill wastes	• Close the landfill in compliance with ARARs and, thereby, protect human health and the environment	• Engineered cap • Flood control measures • Groundwater and landfill gas monitoring • Access restrictions • ICs	Remedy in place; operating properly and successfully

Table ES-1. (Continued)

OU	Other Federal Agency Name	Description	Contaminant Types	Remedial Action Objectives	Remedy	Remedy Status
OUs That Are Protective (cont'd)						
5	Basewide	FT-10C/ST-68	VOCs, TPH, lead	• Achieve cleanup standards for COCs • Mitigate any potential or residual source of groundwater contamination that may be present • Excavation of lead-contaminated soil For ICs: • Prevent unacceptable human exposure to soil vapor or residual contamination • Protect integrity of remedial system, including the monitoring system • Protect necessary access to remedial and monitoring systems	• SVE and/or BV treatment of contaminated soils • Excavation and off-site disposal of lead-contaminated soil • ICs	• Remedy complete; ICs to protect remedial system no longer necessary • ICs to prevent unacceptable exposure to residual soil vapor remain
		LF-18	VOCs	• Mitigate any potential or residual source of groundwater contamination that may be present For ICs: • Prevent unacceptable human exposure to soil vapor or residual contamination • Protect integrity of remedial system, including the monitoring system • Protect necessary access to remedial and monitoring systems	• SVE • ICs	• Remedy complete; ICs to protect remedial system no longer necessary • ICs to prevent unacceptable exposure to residual soil vapor remain

Table ES-1. (Continued)

OU	Other Federal Agency Name	Description	Contaminant Types	Remedial Action Objectives	Remedy	Remedy Status
OUs That Are Protective (cont'd)						
5 (cont'd)	Basewide (cont'd)	OT-23	VOCs	• Mitigate any potential or residual source of groundwater contamination that may be present For ICs: • Prevent unacceptable human exposure to soil vapor or residual contamination • Protect integrity of remedial system, including the monitoring system • Protect necessary access to remedial and monitoring systems	• SVE • ICs for a portion of subsite OT-23C	• Remedy for OT-23C operating properly and successfully • Remedy for subsites OT-23A, B, and D addressed with SVE for other sites.
		OT-87	Arsenic, lead, and SVOCs	• Protection of human health, groundwater quality, surface-water quality, and ecological receptors • ICs to prevent unacceptable human exposure to residual lead contamination.	• Excavation • Backfill with clean soil • Separation of lead shot • Treatment of soil containing lead • Disposal at Site WP-07 • ICs • Confirmatory small mammal monitoring • Reporting of dead waterfowl	• Excavation complete • ICs in place to protect human health • Confirmatory small mammal monitoring conducted • No dead waterfowl have been observed

Table ES-1. (Continued)

OU	Other Federal Agency Name	Description	Contaminant Types	Remedial Action Objectives	Remedy	Remedy Status
OUs That Are Protective (cont'd)						
6	Supplemental Basewide	OT-89	Lead	• Prevent unrestricted human exposure to lead concentrations >192 mg/kg • Prevent plant exposure to lead concentrations >700 mg/kg • Prevent disturbance of subsurface soil that could threaten water quality.	• ICs	• ICs in place to prevent exposure to lead in soil.
		SD-80, SD-85, DD-88			• Excavation of contaminated sediment prior to the ROD	Remedy complete
		Suspected Ordnance Disposal Area of Concern	None identified		• No further action	No further action

ACL	=	aquifer cleanup level	POL	=	petroleum, oil, and lubricants
AC&W	=	Aircraft Control and Warning	ROD	=	Record of Decision
ARAR	=	Applicable or Relevant and Appropriate Requirement	SAC	=	Strategic Air Command
BV	=	bioventing	SD	=	storm drain
COC	=	contaminant of concern	SS	=	sanitary sewer
ESD	=	explanation of significant differences	ST	=	storage tank
FT	=	fire training	SVE	=	soil vapor extraction
IC	=	institutional control	SVOC	=	semivolatile organic compound
LF	=	landfill	TCE	=	trichloroethene
mg/kg	=	milligrams per kilogram	TPH	=	total petroleum hydrocarbons
NA	=	not applicable	VOC	=	volatile organic compound
OT	=	other	WP	=	waste pit
OU	=	operable unit	µg/L	=	micrograms per liter
PFC	=	perfluorinated compound	>	=	greater than

Issues of Concern/Next Steps

This five-year review identifies two issues that need to be addressed and makes recommendations for follow-up actions. These issues do not affect current protectiveness.

Main Base/SAC Area Plume and Site 7 Plume Issue (OU 2, Groundwater OU)

PFCs are chemicals that have been classified as emerging environmental contaminants. They are associated with the use of the aqueous film-forming foam that was used in past fire training practices at Air Force Bases. As emerging environmental contaminants, the Air Force is investigating whether PFCs could be present in the environment at Mather. To that end, influent and effluent samples were collected in September 2014 from the Main Base/SAC Area and Site 7 groundwater treatment plants and analyzed for PFCs. PFCs were detected in samples from both treatment plants; however, the only result to exceed EPA's Provisional Health Advisory Level of 0.2 μg/L was one compound, perfluorooctane sulfonate (PFOS) (at 0.279 μg/L) in a sample from the Main Base/SAC Area plant.

The remedies for both plumes are protective in the short-term, because institutional controls are in place to prevent exposure to the contaminated groundwater. Similarly, there are no promulgated cleanup standards for PFCs and no evidence that the remedy is not protective based on the PFC sampling results to date. Nevertheless, long-term protectiveness is deferred due to the presence of the emerging contaminants, PFCs. The recommendation is to conduct follow-up groundwater sampling for PFC analysis in both plumes. See Sections 7.3.1.3 and 7.3.2.3 in the body of the five-year review for more information.

Site SD-59 Issue (OU 3, Soil OU)

Remediation at Site SD-59 was evaluated for rebound and potential closure in 2014. As part of that evaluation, additional shallow soil vapor wells were installed to define the extent of contamination east of the original sources, a washrack and oil/water separator. Results suggest that contamination from the original site has been remediated, and that there may be a new source outside of the current Site SD-59 IC boundary, near Building 4260. Building 4260 is mostly a large, open, hangar-type structure that is likely well-ventilated, mitigating vapor intrusion issues. However, the offices located along the south wall, closer to the new wells, are more enclosed spaces, and, therefore, have a potential indoor air risk concern. The recent shallow soil vapor sampling results exceed the calculated TCE commercial/industrial indoor air risk soil vapor screening level, although the results are within the EPA risk management range of 1 in one million to 100 in one million. These data also correspond to a noncancer hazard index value of 4.7. These concentrations suggest that additional investigation and assessment activities are necessary in this area. Also, the IC boundary should be extended to the south and east to include this area. See Section 7.4.4.1 for additional information.

Protective Operable Units

All of the OUs and remedies at Mather are protective of human health and the environment, at least in the short term. This five-year review found no outstanding issues related to protectiveness for the following OUs:

- OU 1, the AC&W OU (Sections 7.1 and 7.2)
- OU 4, the Landfill OU (Sections 7.1 and 7.5)
- OU 5, the Basewide OU (Sections 7.1 and 7.6)

- OU 6, the Supplemental Basewide OU (Sections 7.1 and 7.7)

More information on each of these OUs can be found in the body of the text of this document, in the subsections referenced for each.

The remainder of the 89 sites originally identified at Mather do not require an evaluation in the five-year review. See Table 1-2 for more information.

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1.0 INTRODUCTION

This is the fourth five-year review report for remedial actions performed at the former Mather Air Force Base (Mather) pursuant to the Records of Decision (RODs) for Operable Units (OUs) 1 through 6, as modified by one memorandum of post-ROD changes and eight explanations of significant difference(s) (ESD). The RODs, ESDs, and post-ROD memo are as follows:

Operable Unit 1

Superfund Record of Decision: Aircraft Control and Warning Site (AC&W), *Mather Air Force Base, Sacramento County, California* (Air Force Base Conversion Agency [AFBCA], 1993), referred to as the AC&W OU ROD.

Explanation of Significant Difference to the AC&W OU Record of Decision: Discharge of Treated Groundwater to Mather Lake (AFBCA, 1997a).

Explanation of Significant Difference: Institutional Controls for Groundwater Remedy, Site WP-12, Aircraft and Control Warning Site, Mather, California (Air Force Real Property Agency [AFRPA], 2008a).

Operable Units 2 and 3

Superfund Record of Decision, Soil Operable Unit Sites and Groundwater Operable Unit Plumes, Mather Air Force Base, Sacramento County, California (AFBCA, 1996a), referred to as the Soil OU and Groundwater OU ROD.

Explanation of Significant Differences from the Record of Decision, Disposal of Contaminated Soil at Site 7/11 (AFBCA, 1998a).

Explanation of Significant Differences, Soil Operable Unit Sites and Groundwater Operable Unit Plumes Record of Decision for Sites 56, 59, and 60 (AFBCA, 1998b).

Explanation of Significant Difference from the Record of Decision for the Soil Operable Unit Sites and Groundwater Operable Unit Plumes: Soil Sites WP-07/FT-11, ST-37/ST-39/SS-54, SD-57, SD-59, OT-69; Main Base/SAC Area Plume, Site 7 Plume, Northeast Plume, Mather, California (AFRPA, 2010a), referred to as the 2010 Soil OU and Groundwater OU ESD.

Operable Unit 4

Superfund Record of Decision, Landfill Operable Unit Sites, Mather Air Force Base, Sacramento County, California (AFBCA, 1995a), herein referred to as the Landfill OU ROD.

Explanation of Significant Difference from the Record of Decision, Consolidation of Additional Refuse & Debris into Landfill Site 4 (AFBCA, 1996b).

Memorandum of Post-ROD Changes: Clarification of Institutional Controls for the Landfill Operable Unit Remedies, Mather, California (AFRPA, 2009a), referred to as the Memorandum of Post-ROD Changes.

Operable Unit 5

Record of Decision, Basewide Operable Unit Sites, Mather Air Force Base, California (AFBCA, 1998c), referred to as the Basewide OU ROD.

Explanation of Significant Difference from the Record of Decision Excavation of Shallow Soil Contaminated with Lead at Site 10C/68 (AFRPA, 2008b).

Explanation of Significant Difference from the Record of Decision for the Basewide Operable Unit Sites: Sites FT-10C/ST-68, LF-18, OT-23C, and OT-87, Mather, California (AFRPA, 2010b), referred to as the 2010 Basewide OU ESD.

Operable Unit 6

Record of Decision for the Supplemental Basewide Operable Unit Sites, Mather Air Force Base, Sacramento County, California (AFRPA, 2006), referred to as the Supplemental Basewide OU ROD.

Five-year reviews of remedial actions at Mather are required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure. This fourth five-year review for Mather covers the period from 30 September 2010 through 30 September 2015, based on the United States Environmental Protection Agency's Region 9 (EPA) concurrence of the third five-year review on 30 September 2010. Data evaluated for this fourth five-year review cover the period from January 2009 through September 2014. This dataset follows the dataset (January 2004 through early 2009) covered by the third five-year review. Due to the time needed to prepare a five-year review in accordance with the *Comprehensive Five-Year Review Guidance* (EPA, 2001) and complete the review cycle process in accordance with the Federal Facility Agreement (FFA) (United States Air Force, 1989), including draft, draft final, and final versions of the report, evaluating data collected through 30 September 2015 for this fourth five-year review is not feasible. Data collected after 30 September 2014 and not evaluated for this fourth five-year review will be included in the fifth five-year review.

1.1 Purpose and Statement of Authority

A five-year review determines whether the remedial response actions are protective of human health and the environment and, as necessary, provides recommendations for attaining and/or maintaining sustainable protection. As this is the fourth five-year review for remedial actions at Mather, this review evaluated changes in remedy implementation during this five-year period and actions taken in response to recommendations in the *Third Five-Year Review Report* (URS Group, Inc. [URS], 2010).

Executive Order 12580 delegates review responsibility to federal facilities that control the sole source(s) of the release(s). This five-year review for Mather was conducted by the United States Air Force (Air Force), using URS under contract to the Air Force Civil Engineer Center (AFCEC). This report will become part of the Administrative Record for Mather.

The Air Force is responsible for managing the Installation Restoration Program (IRP) at Mather. The IRP at Mather is managed in accordance with the FFA developed specifically for Mather. The FFA ensures that environmental impacts are thoroughly investigated and that appropriate cleanup actions are taken to protect human health, welfare, and the environment. As described in the FFA, authority for IRP decision making rests with a team of remedial project managers (RPMs) from the Air Force, EPA, and the State of California. The State of California is represented by the California Environmental Protection Agency (Cal/EPA), Department of Toxic Substances Control (DTSC), in coordination with the Central Valley

Regional Water Quality Control Board (CVWB), Department of Resources Recycling and Recovery (CalRecycle), and other state agencies as appropriate. The Air Force is the lead agency responsible for funding and implementing remedial actions. The Air Force and EPA jointly select remedies. In cases of disagreement, EPA solely chooses remedial actions. EPA and the state also provide regulatory oversight, including technical support, review, and comments on all CERCLA investigative and remedial work at Mather.

The Air Force is providing this five-year review report in accordance with CERCLA Section (§)121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The EPA interpreted this requirement further in the NCP; Title 40, Code of Federal Regulations (CFR), §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

1.2 Previous Five-Year Review Reports

Five-year reviews were conducted in 1999, 2004, and 2009. The first review was documented in the *Five-Year Review of Remedial Actions* (AFBCA, 1999a); the second review was documented in the *Second Five-Year Review of Remedial Actions* (AFRPA, 2005); and the third review was documented in the *Third Five-Year Review Report* (URS, 2010). These reports can be accessed at http://afcec.publicadmin-record.us.af.mil/Search.aspx or at http://cumulis.epa.gov/fiveyear/. Note that the draft final version of the *Third Five-Year Review Report* is posted on EPA's website; this is the version of the report for which EPA provided their concurrence.

1.3 Fourth Five-Year Review Report

This fourth five-year review was prepared using the guidelines provided in the *Comprehensive Five-Year Review Guidance* (EPA, 2001) and supplements (EPA, 2011a; 2012a; 2012b). The triggering action for this review is the date of EPA's concurrence on the third five-year review, which was 30 September 2010. In general, data collected from 1 January 2009 through 30 September 2014 were reviewed for the technical assessment in this fourth five-year review, including those data presented and evaluated in the monthly, quarterly, semiannual, and/or annual progress monitoring reports cited throughout this document, where appropriate. However, more recent data and analyses (through November 2014) are included for some sites. Section 6.3 includes more specific information on the documents and data reviewed for this fourth five-year review.

This five-year review addresses the IRP sites at Mather that trigger either a statutory review or a policy review. Five-year statutory reviews are required by statute for all sites for which a remedial action is selected that will result in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. Policy reviews are conducted for sites that, upon completion of remedial action, will allow unlimited use and unrestricted exposure, but that will require at least 5 years from the date of the completion of remedy construction to attain ROD-specified cleanup levels. This review identifies Mather sites that fit EPA's definitions for statutory or policy reviews. The five-year review is the same, however, regardless of whether it is required by statute, or identified in EPA guidance as a site to be reviewed as a matter of policy. Table 1-1 lists the Mather's IRP sites, their remediation status, and whether the review is required by statute or policy. For completeness, Table 1-2 identifies the Mather IRP sites that do not require a five-year review because contaminants do not remain at those sites at concentrations that preclude unlimited use and unrestricted exposure.

Table 1-1. Installation Restoration Program Sites that Require a Five-Year Review

Site ID	Site Description	OU	Requirement for Review		Comments
			Statutory	Policy	
LF-03	NE Perimeter Landfill No. 1	4	X		Cap in place; LTO&M; ICs.
LF-04	NE Perimeter Landfill No. 2	4	X		Cap in place; LTO&M; ICs.
WP-07	"7100" Waste Pit Area Disposal Site	3	X		Cap in place; LTO&M; ICs. SVE operated between September 1998 and March 2006; BV operated between April 2007 and May 2009. SVE/BV system closed with regulatory agency concurrence in 2011; components decommissioned in 2012 (remediated with FT-11).
FT-10C	Former Fire Training Area 3 (revised location)	5	X		Site Closed with ICs. SVE system shut down in August 2008; excavation of lead contaminated soil in November 2008. SVE system closed with regulatory agency concurrence in 2012; SVE system and components decommissioned in 2012 (remediated with ST-68).
FT-11	Existing Fire Training Area (used from 1958 to 1993)	3	X		ICs; SVE operated between September 1998 and March 2006; BV operated between April 2007 and May 2009. Closed with regulatory agency concurrence in 2011; SVE/BV system and components decommissioned in 2012 (remediated with WP-07).
WP-12	AC&W Site	1		X	Groundwater extraction and treatment since 1994; ICs. OPS concurrence by EPA in 1998.
LF-18	Old Burial Site (north of Facility 4120)	5	X		Site closed with ICs. SVE shut down in November 2008 (treatment system at SD- 59); ICs. System closed with regulatory agency concurrence in 2012; SVE system and components decommissioned in 2012.

Table 1-1. (Continued)

Site ID	Site Description	OU	Requirement for Review Statutory	Requirement for Review Policy	Comments
OT-23	Main Base Sanitary Sewer System	5		X	SVE operating since April 2000; ICs.
ST-37	Five Former USTs at Bioenvironmental Storage Yard, Facility 3389	3		X	SVE operated between December 1998 and January 2010; BV since October 2010 (remediated with ST-39 and SS-54); ICs.
ST-39	Eight Former USTs at Hazardous Waste Storage Facility 4305	3		X	SVE operating between December 1998 and January 2010; BV since October 2010 (remediated with ST-37 and SS-54); ICs.
SS-54	Hazardous Waste Accumulation Point at AGE Shop, Facility 4348	3		X	SVE operating between December 1998 and January 2010; BV since October 2010 (remediated with ST-37 and ST-39); ICs.
SD-57	OWS at Facility 7019	3		X	SVE operating since August 1997; ICs.
SD-59	OWS at ATC Wash Rack, Facility 4251	3		X	Excavation; SVE operating since February 2000; ICs.
ST-68	Eighteen USTs for SAC Area JP-4 Hydrant System	5	X		Site closed with ICs. SVE system shut down in August 2008; excavation of lead contaminated soil in November 2008; ICs. SVE system closed with regulatory agency concurrence in 2012; SVE system and components decommissioned in 2012 (remediated with FT-10C).
OT-69	Ordnance Burning and Detonation Area	3	X		Site closed with ICs. Excavation of surface soil and sediments; closed with RAR concurrence in October 2003. Temporary ICs added by 2010 Soil OU and Groundwater OU ESD until removal of munitions debris and clearance activities completed under the MMRP in 2011. Closed with EPA concurrence in 2012.
OT-87	Rod and Gun Club Skeet and Trap Range (Facility 10330)	5	X		Site closed with ICs. Excavation and soil stabilization; small mammal monitoring completed in 2009.
OT-89	Old Trap Range	6	X		Site closed with ICs.
	Main Base/SAC Area Plume	2		X	Phased groundwater extraction and treatment since 1998; ICs. OPS concurrence by EPA in 2011.
	Northeast Plume	2		X	Long-term groundwater monitoring since 1996; ICs. OPS concurrence by EPA in 2011.

Table 1-1. (Continued)

Site ID	Site Description	OU	Requirement for Review: Statutory	Requirement for Review: Policy	Comments
OT-89 (cont'd)	Site 7 Plume	2		X	Groundwater extraction and treatment since 1999; intermittent operation due to mining activities; system has operated consistently since December 2006; ICs. OPS concurrence by EPA in 2011.

AC&W	=	Aircraft Control and Warning	No.	=	number
AGE	=	aerospace ground equipment	OT	=	other
ATC	=	Air Training Command	OPS	=	operating properly and successfully
BV	=	bioventing	OU	=	operable unit
EPA	=	United States Environmental Protection Agency	OWS	=	oil-water separator
ESD	=	explanation of significant difference	RAR	=	remedial action report
FT	=	fire training	SAC	=	Strategic Air Command
IC	=	institutional control	SD	=	storm drain
ID	=	identification	SS	=	sanitary sewer
JP-4	=	jet propellant fuel	ST	=	storage tank
LF	=	landfill	SVE	=	soil vapor extraction
LTO&M	=	long-term operations and maintenance	UST	=	underground storage tank
MMRP	=	Military Munitions Response Program	WP	=	waste pit
NE	=	northeast			

Note that for the Soil OU and Basewide OU, their respective ESDs add institutional controls (ICs) to sites that are subject to policy reviews for this fourth five-year review and will trigger statutory reviews for the fifth five-year review, if the sites are closed with ICs during the period covered by the fifth five-year review. If the sites are not closed during the period of the fifth five-year review, a policy review will still be required. Sites in this category include OT-23, ST-37, ST-39, SS-54, SD-57, and SD-59.

Table 1-2. Installation Restoration Program Sites that Do Not Require a Five-Year Review

Site ID	Site Description	OU	Comments
LF-01	Runway Overrun Landfill	4	NFA in Landfill OU ROD.
LF-02	"8150" Area Landfill	4, 5	Landfill waste moved to Site LF-04 as removal action; confirmed as selected remedy in Basewide OU ROD; closed with RAR concurrence in September 2000.
LF-05	NE Perimeter Landfill No. 3	4	Landfill waste moved to Site LF-04; clean closure certified in 1997; groundwater monitoring associated with LF-05 remedy completed.
LF-06	Firing Range Area Landfill Sites	4	Landfill waste moved to Site LF-04; clean closure certified in 1997; groundwater monitoring completed in 2002; regulatory agency concurrence in April 2003.
FT-08	Former Fire Training Area 1	5	NFA in Basewide ROD.
FT-09	Former Fire Training Area 2 (used from 1945 to 1947)	3	NFA in Soil OU and Groundwater OU ROD.
FT-10	Former Fire Training Area 3 (used from 1947 to 1958)	3	NFA in Soil OU and Groundwater OU ROD.
SD-13	Drainage Ditch No. 1 (east of Facility 2950)	3	Excavation of ditch sediment and surface soils; closed with RAR concurrence in September 2000.

Table 1-2. (Continued)

Site ID	Site Description	OU	Comments
SD-14	Drainage Ditch No. 2 (northeast of Facility 3975)	3	NFA in Soil OU and Groundwater OU ROD.
SD-15	Drainage Ditch No. 3 (West), includes OWS Facility 7039	3	Excavation of ditch sediment; closed with RAR concurrence in September 2001.
RW-16	Electron Tube Burial Site under Facility 8170	3	NFA in Soil OU and Groundwater OU ROD.
WP-17	Weapons Storage Area Septic Tank (south of Facility 18080)	5	NFA in Basewide OU ROD.
WP-19[a]	Fuel Tank 4015 and Sludge Burial Site (near Facility 4012)	3	NFA in Soil OU and Groundwater OU ROD; closed by CVWB letter in February 2002.
ST-20	Sewage Treatment Plant UST and Sludge Drying Beds	3/5	Closed with RAR concurrence in May 2012 following completion of ROD-required groundwater sampling for phthalates in 2009; phthalates were not detected. UST closure letters from SCEMD in June 1987 and June 1998; UST also closed by CVWB letter in May 1998.
OT-21	Asphalt Rubble Storage Site (northeast of Facility 7125)	3	NFA in Soil OU and Groundwater OU ROD.
OT-22	Asphalt Rubble Storage Site	3	NFA in Soil OU and Groundwater OU ROD.
ST-24	JP-4 Spill Site at SAC Aircraft Parking Apron	3	NFA in Soil OU and Groundwater OU ROD.
ST-25	Former UST for Emergency Generator, Facility 10100	1	NFA in AC&W ROD; also closed by CVWB letter in November 2001.
ST-26	Former UST for ILS Localizer Emergency Generator, Facility 10072	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2001.
ST-27	Former UST for Communications Transmitter Emergency Generator, Facility 10060	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in August 2001.
ST-28	Former UST for Water Supply Emergency Generator, Facility 16100	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2001.
ST-29[a]	Four Former USTs at Military Gas Station, Facility 3167	3	NFA in Soil OU and Groundwater OU ROD, but remains to be closed under other regulations. SVE operated between August 1995 and October 2009; BV operating since October 2010 (remediated with ST-71 by treatment system for Sites 37/39/54).
ST-30	Former UST Security Police Emergency Generator, Facility 10300	1	NFA in AC&W ROD; also closed by CVWB letter in November 2001.
ST-31	Former UST Transmitter Emergency Generator, Facility 10090	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2001.

Table 1-2. (Continued)

Site ID	Site Description	OU	Comments
ST-32[a]	Six Former USTs at AAFES Service Station, Facility 2410	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in April 1997.
ST-33	Six Former USTs at Civil Engineering Paint Shop, Facility 3308	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in August 2001.
ST-34[a]	Five Former USTs at AAFES Service Station, Facility 21030	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2000.
ST-35[a]	Four Former USTs at POL Yard 1, Facility 3226	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in February 2005.
ST-36 [a]	Four Former USTs at Old Rail Yard 2, Facility 3286	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in February 2005.
ST-38	Two Former USTs at Bioenvironmental Storage Yard, Facility 3388	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2001.
ST-40	Former UST for Training Classroom Boiler, Facility 3875	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in January 1991 and CVWB letter in August 2001.
ST-41	Two Former USTs at Old Motor Pool, Facility 2995	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in January 1991and CVWB letter in August 2001.
ST-42	Former UST at Old Motor Pool, Facility 2898	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in January 1991and CVWB letter in August 2001.
ST-43	Two Former USTs Water Supply Emergency Generator, Facility 10150	3	NFA in Soil OU and Groundwater OU ROD; closed by SCEMD letters in January 1991and October 1996.
SD-44	Former OWS at old Weapons Storage Area, Facility 8540	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in January 1991.
ST-45	Former Ammonia UST for Missile Facility, Facility 7003	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in January 1991.
ST-46	Former UST for Alert Crew Emergency Generator, Facility 8158	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996.
ST-47	Former UST near Security Police Facility 10400B	1	NFA in AC&W ROD; also closed by SCEMD letter in October 1996.
ST-48	Former UST for Security Police Facility 10410	3	NFA in Soil OU and Groundwater OU ROD.
ST-49	Former UST for Security Police Facility 10450	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2001.
ST-50	Same as ST-34	NA	
ST-51	Former UST for ILS Glide Slope Emergency Generator Facility 10030	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996.

Table 1-2. (Continued)

Site ID	Site Description	OU	Comments
ST-52	Former UST for Security Police Emergency Generator Facility 10400A	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996.
ST-53	Former UST for Weapons Storage Area Boiler, Facility 18051	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996.
SD-55	OWS at Facility 7038	3	NFA in Soil OU and Groundwater OU ROD.
SD-56	OWS at former Motor Pool Wash Rack, Facility 2989	3	Excavation followed by SVE and BV; closed with RAR concurrence in October 2002.
SD-58	OWS at Army Helicopter Wash Rack, Facility 4771	3	NFA in Soil OU and Groundwater OU ROD.
SD-60	OWS at Facility 6900 (north side of Facility 7005)	3	Excavation followed by SVE; closed with RAR concurrence in February 2002.
SD-61	OWS at Facility 6905 (south side of Facility 7005)	3	NFA in Soil OU and Groundwater OU ROD.
OT-62	OWS at Facility 7110 (Jet Engine Test Stand Facility 7099)	3	Excavation of surface and shallow subsurface soil; closed with RAR concurrence in June 2001.
SD-63	OWS and two USTs at former Auto Hobby Shop, Facility 3320	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in October 1996.
SD-64	OWS at Fuel Truck Wash Rack, Facility 4120	3	NFA in Soil OU and Groundwater OU ROD.
SD-65	OWS at Facility 6910 (north corner of Facility 7009)	3	Excavation of surface and shallow subsurface soils; closed with RAR concurrence in September 2000.
SD-66	OWS at Facility 6915 (north corner of Facility 7024)	3	NFA in Soil OU and Groundwater OU ROD.
SD-67	Sanitary Sewer System in the SAC Area	5	NFA in Basewide OU ROD.
ST-70	Former UST at Dining Hall, Facility 1226	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in August 1994 (referred to as Site A in ROD).
ST-71[a]	Five Former USTs at AVGAS Pumping Station, Facility 3271	3	NFA in Soil OU and Groundwater OU ROD, but remains to be closed under other regulations. SVE operated between August 1995 and October 2009; BV operating since October 2010 (remediated with ST-29 by treatment system for Sites 37/39/54). ST-71 referred to as Site B in ROD.
ST-72	Former UST at Water Plant, Facility 3975	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996 (referred to as Site C in ROD).
ST-73	Former UST for ILS Localizer Emergency Generator Facility 10015	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996 (referred to as Site E in ROD).
ST-74	Former UST for Utility Vault Emergency Generator Facility 10065	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996 (referred to as Site F in ROD).
ST-75	Former UST at Weapons Storage Area, Facility 18018	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996 (referred to as Site G in ROD).

Table 1-2. (Continued)

Site ID	Site Description	OU	Comments
ST-76	Former UST at Weapons Storage Area, Facility 18011 and 18020	3	NFA in Soil OU and Groundwater OU ROD; 18011 also closed by SCEMD letters in June 1996; 18011 and 18020 referred to as Site H in ROD.
ST-77	Former UST Army Helicopter Pad, Facility 4853	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in October 1996 (referred to as Site I in ROD).
ST-78	Two USTs East of Facility 2527 (2527 and 2527B)	NA	Closed by SCEMD letters in June 1987, July 1997, and June 1998; 2527B also closed by CVWB letter in May 1998.
ST-79	UST East of Facility 4540	NA	Closed by SCEMD letters in June 1987 and June 1998; also closed by CVWB letter in May 1998.
SD-80	Golf Course Maintenance Area Drainage	6	NFA in Supplemental Basewide OU ROD.
ST-81	Sewage Oxidation Ponds	5	NFA in Basewide OU ROD.
OT-82[a]	Golf Course Maintenance Area (near Facility 8869)	5	NFA in Basewide OU ROD; also closed by CVWB letter in August 1999.
SD-83[a]	Army Aviation Helicopter Washrack (Facility 4771)	5	NFA in Basewide OU ROD, but remains to be closed under other regulations.
SD-84	Sewer Lines SAC Area to Sewage Treatment Plant	5	NFA in Basewide OU ROD.
SD-85	South Ditch (NE Morrison Creek Tributary from Facility 10030 to 10085)	6	NFA in Supplemental Basewide OU ROD.
OT-86	Military Small Arm Firing Range (Facility 12500)	5	Excavation and soil stabilization; closed with RAR concurrence in October 2003.
DD-88	Drainage Ditch Morrison Creek from Mather Lake to AC&W Area	6	NFA in Supplemental Basewide OU ROD.

[a] Petroleum-only, non-CERCLA sites.

AAFES	=	Army Air Force Exchange Service
AC&W	=	Aircraft Control and Warning
AVGAS	=	aviation gasoline
BV	=	bioventing
CERCLA	=	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CVWB	=	Central Valley Regional Water Quality Control Board
DD	=	drainage ditch
FT	=	fire training
ID	=	identification
ILS	=	instrumented landing system
JP-4	=	jet propellant fuel
LF	=	landfill
NA	=	not applicable
NE	=	northeast
NFA	=	no further action
No.	=	number
OT	=	other
OU	=	operable unit
OWS	=	oil-water separator
POL	=	petroleum, oil, and lubricant
RAR	=	remedial action report
ROD	=	record of decision
RW	=	radioactive waste
SAC	=	Strategic Air Command
SCEMD	=	Sacramento County Environmental Management Department
SD	=	storm drain
ST	=	storage tank
SVE	=	soil vapor extraction
UST	=	underground storage tank
WP	=	waste pit

Several suspected or known military munitions sites and areas of concern (AOCs) have been investigated at Mather. Some of these sites and AOCs (e.g., small arms range at Site OT-86 and skeet/trap ranges at Sites OT-87 and OT-89) were investigated and remediated under the IRP and have been included in past five-year reviews for Mather. This fourth five-year review report presents information both on sites and

AOCs investigated and remediated as part of the IRP, but does not include MMRP sites and AOCs investigated as part of the Military Munitions Response Program (MMRP) at Mather.

As outlined in Appendix E of the *Comprehensive Five-Year Review Guidance* (EPA, 2001), this five-year review report is presented in the following sections.

Section 1.0 Introduction: Identifies the purpose of the review, the authority for conducting the review, the areas of the site addressed in the review and those areas not addressed in the review, and the action that triggered the review.

Section 2.0 Site Chronologies: Discusses important site events for each OU.

Section 3.0 Background: Provides a succinct description of site characteristics. This section identifies the threat posed to the public and environment at the time of the ROD so that the performance of the remedy can be easily compared with the site conditions the remedy was intended to address.

Section 4.0 Remedial Actions: Provides a concise description of implementation history and the current status of the remedy.

Section 5.0 Progress Since Last Review: Restates the recommendations from the last five-year review and discusses actions taken or relevant events that have occurred since.

Section 6.0 Five-Year Review Process: Provides an overview of activities performed during the five-year review (e.g., site interviews and document review) and summarizes the findings, as appropriate.

Section 7.0 Technical Assessment: Provides answers to the three questions required for the assessment (i.e., Question A: Is the remedy functioning as intended by the decision documents? Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives [RAOs] used at the time of remedy selection still valid? Question C: Has any other information come to light that could call into question the protectiveness of the remedy?).

Section 8.0 Issues Identified During the Five-Year Review, Recommendations, and Follow-Up Actions: Identifies issues related to current site operations, conditions, or activities, noting which issues, if any, prevent the remedy from being protective, currently or in the future. Specifies required and suggested improvements to current site operations, activities, remedies, or conditions for those issues that affect current and/or future protectiveness.

Section 9.0 Protectiveness Statement: Provides a protectiveness statement for each OU.

Section 10.0 Next Five-Year Review: Identifies the need and time frame for the next five-year review.

Section 11.0 References: Provides reference information for sources cited in the report.

The report is supplemented with the following appendices:

Appendix A: Operational and Remedial Histories of the SVE/Bioventing Systems

Appendix B: Interview Records

Appendix C: Regulatory Agency Comments and Responses to Comments

Appendix D: Lead 95 Upper Confidence Limit Calculations and Blood Lead Level Estimates

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2.0 SITE CHRONOLOGIES

This section incorporates information about the site chronology for Mather as a whole, followed by a chronology of major events for each IRP site at Mather that requires a five-year review. For site chronology information on IRP sites that do not require a five-year review, refer to the five RODs listed in Section 1.0, closure and remedial action reports (RARs), and the first, second, and third five-year reviews (AFBCA, 1999a; AFRPA, 2005; URS, 2010). These documents are available in the Administrative Record for Mather, 3411 Olson Street, McClellan, California 95652, or online at http://afcec.publicadmin-record.us.af.mil/Search.aspx.

2.1 Overview of Mather Air Force Base History

There are 89 IRP sites at Mather, as shown on Figure 2-1. There are also four major volatile organic compound (VOC) groundwater plume areas (Figure 2-1). The 89 IRP sites have been grouped into six OUs, based on similarities in contaminants, affected media, and/or timing of cleanup decisions. OU 1 (referred to as the AC&W OU) consists of a contaminated groundwater plume, as well as three sites where underground storage tanks (USTs) were removed. OU 2 (referred to as the Groundwater OU) consists of three other contaminated groundwater plumes. OU 3 (referred to as the Soil OU) comprises contaminated soil associated with waste disposal pits, oil-water separators (OWS), gas stations, USTs, fire training areas, and other contaminated soil sites. OU 4 (referred to as the Landfill OU) consists of six sites where municipal waste was buried. OUs 5 and 6 (referred to as the Basewide OU and Supplemental Basewide OU, respectively) consist of the contaminated soil sites not included in other OUs.

2.2 OU 1 (AC&W OU) Chronology

The AC&W site is the location of a radar station now operated by the Federal Aviation Administration (FAA) but formerly operated jointly by the FAA and the Air Force. The AC&W OU consists of IRP Site WP-12 and three nearby IRP sites (ST-25, ST-30, and ST-47) where USTs were removed between 1987 and 1993 (Figure 2-1). No further action was required at the UST sites per the AC&W OU ROD. Figure 2-1 shows the lateral extent of the AC&W groundwater plume as of the fourth quarter of 2013 (4Q13).

2.2.1 AC&W Plume

In 1979, the water supply well serving the AC&W area was sampled by the Air Force and found to be contaminated with the VOC trichloroethene (TCE). Investigations in the 1980s revealed a TCE plume extending from the vicinity of the radar site approximately 1 mile southwest to the family housing area, predominantly in the upper 60 feet of the water table aquifer. The maximum concentration of TCE reported was approximately 1,000 micrograms per liter (μg/L).

Remedial investigation/feasibility study (RI/FS) activities, which included a baseline risk assessment, were completed in 1991 (IT Corporation, 1991a; 1991b). A Proposed Plan was released to the public in August 1991 (Headquarters Air Training Command, 1991). A revised Proposed Plan was released to the public in March 1992 (Headquarters Air Training Command, 1992), and the AC&W OU ROD was signed in December 1993 (AFBCA, 1993). The ROD-specified pump-and-treat remedial action with discharge of treated effluent to injection wells began operating in December 1994. However, because the injection system could not accommodate the planned flow rate of effluent from the treatment plant, extraction operated at approximately half the planned rate until treated water was diverted from the injection system to surface water discharge at Mather Lake starting in June 1997. The change in the discharge component of the remedy is documented in the *Explanation of Significant Difference to the AC&W OU Record of Decision: Discharge of Treated Groundwater to Mather Lake* (AFBCA, 1997a).

In September 1998, the Air Force issued a report of proper and successful operation (a.k.a. operating properly and successfully [OPS]) for the AC&W remedial action (AFBCA, 1998d), which received EPA concurrence in November 1998 (EPA, 1998).

In 2008, ICs were added to the groundwater remedy through a second ESD for the AC&W OU (AFRPA, 2008a).

In 2009, the injection wells were decommissioned (MWH Americas, Inc. [MWH], 2009a), and in 2013, two extraction wells no longer needed for groundwater cleanup were decommissioned (URS, 2013a). During the period of this five-year review, there was one major interruption in operation of the AC&W extraction wells and treatment system. At the end of December 2012, the groundwater treatment plant was extensively damaged by vandals, and the system was offline until mid-March 2013 for repairs and security upgrades.

2.3 OU 2 (Groundwater OU) Chronology

The Groundwater OU consists of all groundwater contamination originating from sources at Mather, except the AC&W OU Plume (see Section 2.2). The Groundwater OU has been subdivided into the following four plumes with their apparent major sources in parentheses:

- Main Base Plume (dry cleaner at IRP Site OT-23C)
- Strategic Air Command (SAC) Industrial Area Plume (OWS at IRP Site SD-57)
- Site WP-07 Plume (waste pit at IRP Site WP-07)
- Northeast Plume (landfills at IRP Sites LF-03 and LF-04)

The RI for the Groundwater OU identified VOC plumes in groundwater beneath Mather (IT Corporation, 1993a). In March 1995, a focused feasibility study (FFS) of remedial alternatives for the Main Base/SAC Area, Site WP-07, and Northeast Plumes was completed (IT Corporation, 1995a), and the Proposed Plan was released to the public in May 1995 (AFBCA, 1995b). In December 1995, the baseline risk assessment was finalized in preparation for the Soil OU and Groundwater OU ROD (IT Corporation, 1995b). In June 1996, the Soil OU and Groundwater OU ROD was signed, and remedial actions were selected for each of the identified groundwater plumes (AFBCA, 1996a). The remedial actions selected for the Groundwater OU plumes and the startup of those actions are summarized in Sections 2.3.1 through 2.3.3, and are discussed in more detail in Sections 4.0 and 7.0. Known vadose zone sources for the four plumes are addressed as part of the Soil, Landfill, or Basewide OUs and discussed in Sections 2.4 through 2.6. Figure 2-1 shows the lateral extents of the Groundwater OU plumes as of 4Q13.

2.3.1 Main Base/SAC Area Plume

The Soil OU and Groundwater OU ROD combined the Main Base and SAC Industrial Area groundwater plumes for the purpose of remediation based on proximity, common contaminants, and commingling. The contaminants of concern (COCs) for the Main Base/SAC Area Plume include multiple VOCs (see Section 3.5), total petroleum hydrocarbons (TPH) as diesel (TPH-d), TPH as gasoline (TPH-g), and lead. The remedial action selected for the Main Base/SAC Area Plume includes groundwater extraction, air stripping with off-gas treatment (carbon adsorption) as necessary, injection and possibly alternate methods of discharge for treated water, groundwater monitoring, and land-use restrictions. Off-gas treatment has not proven necessary.

The Soil OU and Groundwater OU ROD called for a phased implementation of the remedial action for the Main Base/SAC Area Plume. Phase I extraction wells, addressing hot spots of groundwater contamination on the former base, began operating in April 1998. Phase II extraction wells, addressing off-base hot spots, and Phase III extraction wells, completing plume capture not achieved with Phase I wells, began operating in January 2000. To complete the Phase III expansion, three additional extraction wells were installed and began operating during 3Q01. Phase IV extraction wells, expanding plume capture off base and further augmenting plume capture on Mather, began operating in September 2002. Two additional extraction wells, addressing capture of the off-site leading edges of the plume to the west and southwest of the Main Base/SAC Area, began operating in 2005 and 2008, respectively.

An ESD, finalized in 2010, elaborates upon and clarifies the Groundwater OU land-use restrictions with respect to their implementation and identifies the areas subject to ICs (AFRPA, 2010a).

In March 2011, the Air Force issued an OPS report for the Main Base/SAC Area Plume remedial action (AFRPA, 2011a); that report received EPA concurrence in July 2011 (EPA, 2011b).

Until September 2011, all extracted and treated groundwater was injected into the aquifer using injection wells, except for a limited quantity used by Sacramento County for irrigation of roadside landscaping at Mather. However, due to limited injection well capacity, in September 2011 surface water discharge into the West Drainage Canal (also known as the West Ditch) was implemented in accordance with Soil OU and Groundwater OU ROD applicable or relevant and appropriate requirements (ARARs) (AFBCA, 1996a). Discharge to the West Ditch was suspended in April 2014 after several extraction wells were shut down and Sacramento County began using more of the treated groundwater for irrigation.

2.3.2 Site 7 Plume

The remedial action selected in the Soil OU and Groundwater OU ROD for the Site WP-07 Plume (referred to as the Site 7 Plume) consists of groundwater extraction, treatment by air stripping with off-gas activated carbon treatment as necessary, injection of treated effluent, and land-use restrictions (AFBCA, 1996a). Off-gas treatment has not proven necessary. The COCs for the Site 7 Plume include multiple VOCs (see Section 3.5) and TPH-d. Construction of the Site 7 treatment system was completed in October 1998. Between 1998 and 2004, the Site 7 system operated intermittently as a result of interruptions by off-base aggregate mining activities (described in Section 4.1.3). However, the system has operated continuously with two extraction wells since December 2006.

An ESD, finalized in 2010, elaborates upon and clarifies the Groundwater OU land-use restrictions with respect to their implementation and identified the areas subject to ICs (AFRPA, 2010a).

In June 2011, the Air Force issued an OPS report for the Site 7 Plume remedial action (AFRPA, 2011b); that report received EPA concurrence in July 2011 (EPA, 2011b).

2.3.3 Northeast Plume

The remedial action selected in the Soil OU and Groundwater OU ROD for the Northeast Plume consists of long-term groundwater monitoring and land-use restrictions. The COCs for the Northeast Plume are multiple VOCs (see Section 3.5). The remedy calls for reconsideration of active remediation if monitoring or modeling indicates that the contaminants will not meet cleanup standards within a reasonable time, or within 40 years of the ROD, or indicates that significant migration of the contaminants will occur at concentrations greater than the aquifer cleanup levels (ACLs) that will impact public health or the environment.

An ESD, finalized in 2010, elaborates upon and clarifies the Groundwater OU land-use restrictions with respect to their implementation and identified the areas subject to ICs (AFRPA, 2010a).

In March 2011, the Air Force issued the revised final OPS report for the Northeast Plume remedial action (AFRPA, 2011c); that report received EPA concurrence in July 2011 (EPA, 2011b).

2.4 OU 3 (Soil OU) Chronology

The Soil OU comprises contaminated soils associated with waste disposal pits, OWSs, gas stations, USTs, fire training areas, and sites exposed to other activities. RIs for Soil OU sites were conducted as part of the IRP Program and completed in 1994 (IT Corporation, 1993a, 1993b, 1994a). In March 1995, an FFS of remedial alternatives for the Soil OU sites was completed (IT Corporation, 1995a) and the Proposed Plan was released to the public in May 1995 (AFBCA, 1995b). In December 1995, the baseline risk assessment was finalized in preparation for the Soil OU and Groundwater OU ROD (IT Corporation, 1995b). In June 1996, the Soil OU and Groundwater OU ROD was signed (AFBCA, 1996a).

Remedial actions were selected for 14 IRP sites in the Soil OU and Groundwater OU ROD (AFBCA, 1996a). Of those 14 sites, remedial actions have been completed at seven sites, which now require no further action (Tables 1-1 and 1-2). (Note that temporary ICs were added to the remedy at Site OT-69 in 2010 [AFRPA, 2010a] until munitions debris removal and clearance activities were completed under the Military Munitions Response Program in 2011; the ICs no longer apply.) At the other seven sites, remedial actions were ongoing as of October 2014; those remedial actions are summarized in Sections 2.4.1 through 2.4.4, and are described in more detail in Sections 4.0 and 7.0. Some sites are grouped together because of proximity and a common remedial action. Although all sites may require groundwater monitoring, if contamination that threatens groundwater quality remains at the sites, impact to groundwater underlying these sites is addressed by the Groundwater OU (Site 7 Plume or the Main Base/SAC Area Plume), as discussed in Section 2.3. Figure 2-1 shows the location of the sites discussed below in relation to the groundwater plumes.

2.4.1 Site WP-07/FT-11

Site WP-07 (7100 Area Disposal Site) and Site FT-11 (Existing Fire Training Area) were combined for the purpose of implementing in situ treatment to remediate soil contaminated with TPH-d and TPH-g at these adjoining sites. Site WP-07 is the apparent source area for the Site 7 groundwater contaminant plume that extends off base to the south-southwest (Figure 2-1). The remedial action selected in the Soil OU and Groundwater OU ROD for Site WP-07/FT-11 consists of filling in the depression at Site WP-07 with inert fill; treating the contaminated shallow and deep soils by bioventing (BV) and possibly SVE; installing a prescriptive landfill cover; and land-use restrictions to protect the landfill cover at Site WP-07. The remedy was modified by an ESD to include installation of an engineered cap to allow use of contaminated soil from other sites to build up the cap foundation (AFBCA, 1998a).

The former disposal area was brought up to grade by receiving soils excavated from the West Ditch (Site SD-15), the South Ditch (Site SD-85), and from other IRP cleanup activities. An engineered cap was constructed over the disposal area in 1999. Starting in 1998, VOCs in the vadose zone at Site WP-07/FT-11 were remediated by separate SVE systems, which were later combined and operated with a single treatment unit. In April 2007, the SVE treatment system was converted to a BV system, as volatile contaminant concentrations had significantly decreased. The BV system was permanently shut down in May 2009, and in 2011, a closure report was finalized documenting that no further treatment of the vadose zone is necessary at Site WP-07/FT-11 (URS, 2011a). In 2012, the SVE/BV system and components were decommissioned (URS, 2012a).

An ESD, finalized in 2010, clarifies the implementation of ICs required by the landfill ARARs (AFRPA, 2010a). The ESD replaces numeric soil cleanup levels for TPH-d and TPH-g at Site WP-07/FT-11 with narrative soil cleanup levels. The Site WP-07/FT-11 SVE/BV system and components have been decommissioned; therefore, the ICs related to protection of those components no longer apply, except for the few BV wells not decommissioned because they were retained for use by the Groundwater Monitoring Program.

In June 2011, the Air Force issued an OPS report for the Site WP-07/FT-11 remedial actions (AFRPA, 2011b), which received EPA concurrence in July 2011 (EPA, 2011b).

2.4.2 Site ST-37/ST-39/SS-54

Sites ST-37, ST-39, and SS-54 were grouped for the purpose of implementing in situ treatment to remediate soil contaminated with TPH and benzene, toluene, ethylbenzene, and total xylenes (BTEX) at these adjoining sites. Site ST-37 consisted of five USTs, which were removed. Site ST-39 was the hazardous waste storage yard, and prior to that, a storage and distribution point for aviation gasoline. Site ST-39 also contained pipelines and fuel filter sumps and eight USTs, which were removed. Site SS-54 was the aerospace ground equipment (AGE) repair shop and contained a hazardous waste accumulation point and a wash rack. The remedial action selected in the Soil OU and Groundwater OU ROD for Site ST-37/ST-39/SS-54 includes excavation and ex situ treatment of soil by bioremediation and in situ treatment of contaminated shallow and deep soils by BV and possibly SVE (AFBCA, 1996a).

Prior to excavation, trenching activities were conducted to determine the extent of soil requiring removal to meet the site’s cleanup levels. Based on the trenching results, the site met cleanup levels without further excavation (Montgomery Watson, 2000a). Therefore, no excavation was conducted (except for the soils from the investigative trenches).

An SVE system was constructed in summer 1998, and after a period of startup and troubleshooting, became operational in December 1998. SVE operated until January 2010, and in October 2010 the SVE system was converted to a BV system. The BV system was shut down in December 2013 for respiration testing, and in 2014, the Air Force is scheduled to assess the site for closure of the vadose zone. Note that the SVE/BV system at Site ST-37/ST-39/SS-54 also remediates Site ST-29/ST-71 (a non-CERCLA site).

An ESD, finalized in 2010, adds ICs to the remedy for Site ST-37/ST-39/SS-54 (as well as Subsites OT-23B and OT-23D from the Basewide OU, which are being remediated with Site ST-37/ST-39/SS-54) (AFRPA, 2010a). The ESD replaces numeric soil cleanup levels for BTEX, TPH-d, and TPH-g at Site ST-37/ST-39/SS-54 with narrative soil cleanup levels.

In March 2011, the Air Force issued an OPS report for the Site ST-37/ST-39/SS-54 remedial action (AFRPA, 2011a), which received EPA concurrence in July 2011 (EPA, 2011b).

2.4.3 Site SD-57

Site SD-57 consisted of the former AGE washrack OWS located at Facility 7019. A TCE soil vapor plume extends from this apparent source area to the southwest, overlying the core of the TCE groundwater plume (Figure 2-1). SVE is the remedy selected in the Soil OU and Groundwater OU ROD for Site SD-57 (AFBCA, 1996a).

The SVE system began operating at Site SD-57 in August 1997. In 2001, dual-phase extraction (DPE) was initiated at three water table groundwater extraction wells for the purpose of removing vapor and increasing the groundwater extraction rate for these wells.

An ESD, finalized in 2010, adds ICs to the remedy for Site SD-57 (AFRPA, 2010a).

In March 2011, the Air Force issued an OPS report for the Site SD-57 remedial action (AFRPA, 2011a), which received EPA concurrence in July 2011 (EPA, 2011b).

At the end of July 2013, the SVE system was shut down for rebound monitoring, and in April 2014, a draft closure report was submitted for regulatory agency review; the report documented that no further treatment of the vadose zone was necessary at Site SD-57 (URS, 2014a). However, the results from additional confirmation soil vapor samples collected from the vapor wells in August 2014 prompted the postponement of the closure report and resumption of SVE operations in September 2014.

2.4.4 Site SD-59

Site SD-59 consisted of the former Air Training Command washrack OWS at Facility 4251. Contaminants in soil at Site SD-59 include TPH-d and TPH-g. The remedial action selected in the Soil OU and Groundwater OU ROD for Site SD-59 includes excavation and ex situ treatment of soil by bioremediation (AFBCA, 1996a).

The OWS and surrounding soil were excavated in 1996 in accordance with the remedial action selected in the ROD, but some contamination remained. As a result, the Air Force selected additional remediation by in situ methods (SVE/BV) to address the residual contamination. These methods were documented in an ESD (AFBCA, 1998b). The SVE system was installed and became operational in February 2000, following a pilot test in December 1998..

An ESD, finalized in 2010, adds ICs to the remedy for Site SD-59 (as well as Site LF-18 from the Basewide OU, which was formerly remediated with Site SD-59) (AFRPA, 2010a). The ESD replaces numeric soil cleanup levels for TPH-d and TPH-g with narrative soil cleanup levels at Site SD-59.

In March 2011, the Air Force issued an OPS report for the Site SD-59 remedial action (AFRPA, 2011a), which received EPA concurrence in July 2011 (EPA, 2011b).

At the end of July 2013, the SVE system was shut down for further evaluation, and a closure report was scheduled for preparation in 2014. Data from additional vapor wells installed in 2014 suggest that the original Site SD-59 VOC source area has been remediated, but another source area may exist near Building 4260 (see Figure 4-10) and may pose an excessive indoor air risk. That apparent new source area is outside of the current IC boundary and will be further evaluated. Additional investigation and assessment activities are recommended in this area. It is also recommended that the IC boundary be extended to the south and east to include this area.

2.5 OU 4 (Landfill OU) Chronology

Contamination exists at the Landfill OU sites as a result of base operations conducted between 1918 and 1974. The landfills were mainly used for the disposal of general and sanitary refuse. In addition to garbage and household trash, it was reported that petroleum, oil, and lubricant (POL) wastes, as well as waste solvents, may have been disposed in the landfills. It was also reported that daily burning of the refuse occurred at two of the landfills (Sites LF-03 and LF-04).

Investigations were conducted at the inactive landfill sites during the RI (IT Corporation, 1993a), and in October 1993, an FFS of remedial alternatives was completed for the Landfill OU (IT Corporation, 1993c). In December 1993, the Proposed Plan was released to the public for review and comment (Air Force Center for Environmental Excellence, 1993), and the *Superfund Record of Decision, Landfill Operable Unit Sites, Mather Air Force Base, Sacramento County, California* was signed in July and August 1995 (AFBCA, 1995a).

Remedial actions were selected for five IRP sites in the Landfill OU ROD (AFBCA, 1995a). Of those five sites, remedial actions have been completed at three (LF-02, LF-05, and LF-06), and they require no further action (Table 1-2). The other two sites (LF-03 and LF-04) are undergoing remedial actions. Those remedial actions are summarized in Sections 2.5.1 and 2.5.2 and are discussed in more detail in Sections 4.0 and 7.0. Both sites require groundwater monitoring, and impact to groundwater underlying these sites is addressed in part by the Landfill OU ROD and in part by the Soil OU and Groundwater OU ROD (Northeast Plume monitoring for VOCs), as discussed in Section 2.3. Figure 2-1 shows the location of the sites discussed below in relation to the groundwater plumes.

2.5.1 Site LF-03

Site LF-03 reportedly was the main sanitary landfill for Mather from 1950 through 1967. Site LF-03 is in the northeast portion of Mather (Figure 2-1). The remedial action selected in the Landfill OU ROD for Site LF-03 includes an engineered cap, groundwater and landfill gas monitoring, access restrictions (i.e., fencing and signage) and ICs (i.e., deed restrictions prohibiting incompatible land uses). The site was capped in 1996, and groundwater and landfill gas monitoring continue to the present. In addition, a memorandum of post-ROD changes, finalized in 2009, clarifies and supplements the ICs for Site LF-03 (AFRPA, 2009a).

2.5.2 Site LF-04

Site LF-04, located east of Site LF-03 (Figure 2-1), reportedly was the main sanitary landfill site for the entire Base from 1967 through 1971. The remedial action selected in the Landfill OU ROD for Site LF-4 consists of an engineered cap, flood control measures (i.e., an embankment), groundwater and landfill gas monitoring, access restrictions (i.e., fencing and signage) and ICs (i.e., deed restrictions prohibiting incompatible land uses). The Landfill OU ROD also includes consolidation of wastes excavated from Sites LF-05 and LF-06 into LF-04. The *Explanation of Significant Difference from the Record of Decision, Consolidation of Additional Refuse & Debris into Landfill Site 4* (AFBCA, 1996b) modifies the remedy to include consolidation of waste excavated from Site LF-02 into Site LF-04. The consolidation of waste from Site FT-10C/ST-68 into Site LF-04 was also included by through a consensus statement signed by the RPMs in 1996 before the time-critical removal action memorandum for Site FT-10C/ST-68 was complete (AFBCA, 1996c).

Site LF-04 was capped in 1996 and planted with vegetation in 1997. Groundwater and landfill gas monitoring continue to the present. In addition, a memorandum of post-ROD changes, finalized in 2009, clarifies and supplements the ICs for Site LF-04 (AFRPA, 2009a).

2.6 OU 5 (Basewide OU) Chronology

The Basewide OU comprises sites with contaminated soils associated with an area of suspected waste burial and runoff from aircraft operations, USTs, fire training areas, sewage treatment facilities/systems, a firing range, and a skeet/trap range that are not included in previously described OUs. The Basewide OU sites were investigated under the Mather IRP and are described and evaluated in the RI/FFS documents

(IT Corporation, 1993a; 1993b; 1996a; 1997a; 1997b). The Proposed Plan became available to the public in May 1997 (AFBCA, 1997b). In September 1998, the Basewide OU ROD was signed (AFBCA, 1998c).

Remedial actions were selected for eight IRP sites in the Basewide OU ROD (AFBCA, 1998c). Of those eight sites, remedial actions have been completed at three (LF-02, ST-20, and OT-86), and those sites require no further action (Table 1-2). The other five sites are currently undergoing remedial actions and/or have closed with ICs in place. Sites FT-10C and ST-68 are grouped together because of their proximity and common remedial action. The remedial actions are summarized in Sections 2.6.1 through 2.6.4 and are discussed in more detail in Sections 4.0 and 7.0. Any impact to groundwater underlying these sites is addressed by the Groundwater OU (Main Base/SAC Area Plume), as discussed in Section 2.3. Figure 2-1 shows the location of the sites discussed below in relation to the groundwater plumes.

2.6.1 Site FT-10C/ST-68

Site FT-10C was the site of fire training exercises from approximately 1947 to 1958 where POL waste was ignited and extinguished during training exercises conducted at the site. Site ST-68 is the adjacent site where a fuel storage facility. The fuel storage facility consisted of sixteen 50,000-gallon and two 2,000-gallon USTs for storing jet propellant fuel #4 (JP-4), a fuel distribution manifold, and pumps. (Fire training was relocated to Site FT-11 when the fuel storage system was built.) After site investigation and prior to the signing of the Basewide OU ROD, debris and soil (including lead-impacted surface soil) were excavated from Site FT-10C and disposed at Site LF-04 under a removal action memorandum (AFBCA, 1996c). An additional investigation was conducted and a pilot SVE system was installed in 1997 to determine the extent of subsurface VOC and petroleum hydrocarbon contamination and evaluate the effectiveness of in situ remediation technologies at Site FT-10C/ST-68 (EA Engineering, Science, and Technology [EA Engineering], 1997).

The Basewide OU ROD (AFBCA, 1998c) selected in situ treatment (SVE and/or BV) of subsurface soil contaminated with TPH-d, TPH-g, and BTEX as the remedial action for Site FT-10C/ST-68 SVE and BV were each used as part of the remedy from August 1997 until the SVE system was permanently shut down in August 2008. A closure report, finalized in 2010, documented that no further treatment of the vadose zone is necessary at Site FT-10C/ST-68 (MWH, 2010a). In 2012, EPA concurrence was received (EPA, 2012c), and the SVE/BV system and components were decommissioned (ADVENT Environmental, Inc., 2012).

Additional lead-contaminated soil was discovered at the site in 2002. Therefore, an ESD was prepared to add excavation of the lead-contaminated soil to the remedy for Site FT-10C/ST-68 (AFRPA, 2008b). The lead-contaminated soil was excavated in November and December 2008 and disposed at an appropriately permitted off-site landfill (MWH, 2009b).

Another ESD, finalized in 2010, adds ICs to the remedy at Site FT-10C/ST-68 (AFRPA, 2010b). These ICs address residual VOC contamination in soil only; lead-contaminated soil has been removed to levels that allow for unlimited use and unrestricted exposure (MWH, 2009b; 2010a). Further, the ESD replaces the numeric soil cleanup levels for TPH-d and TPH-g with narrative soil cleanup levels. All of the Site FT-10C/ST-68 SVE/BV system and components have been decommissioned; therefore, the ICs related to protection of those components no longer apply.

2.6.2 Site LF-18

Site LF-18 is adjacent to the aircraft parking apron at the west end of the Main Base flight line (Figure 2-1). Historically, Site LF-18 had been identified as the Old Burial Site; however, investigations found no evidence of landfill or burial activities. Soil contamination (TCE and 1,2-dichloroethene [DCE]) may have resulted from storm runoff or contaminants from the nearby tarmac where aircraft maintenance activities may have occurred, rather than from a burial site. SVE pilot tests were conducted at Site LF-18 in 1993, 1995, and 1998 (IT Corporation, 1995a; 1996b; Montgomery Watson, 1999a). The pilot tests confirmed that SVE was an effective technology to remove VOCs from the soil at Site LF-18. Therefore, SVE using extraction wells and possibly passive injection wells was the remedy selected in the Basewide OU ROD for Site LF-18 (AFBCA, 1998c).

An SVE system operated from 2000 until it was permanently shut down in November 2008. A closure report, finalized in 2010, documented that no further treatment of the vadose zone is necessary at Site LF-18 (MWH, 2010b). In 2012, EPA concurrence was received (EPA, 2012d), and the SVE components (wells and piping only) were decommissioned (ADVENT Environmental, Inc., 2012).

An ESD, finalized in 2010, adds ICs to the remedy to protect human health from the potential risk associated with inhalation of VOCs via the vapor intrusion pathway for Site LF-18 (including Subsite OT-23A) (AFRPA, 2010b). Because Site LF-18 was being remediated with Soil OU Site SD-59, an ESD for the Soil OU remedies (AFRPA, 2010a) included the protection of the remaining SVE piping and wells was included with Site SD-59.However, all of the Site LF-18 SVE piping and wells have been decommissioned, and the ICs related to protection of those components no longer apply.

2.6.3 Site OT-23

Site OT-23 was originally identified and defined as two leaky sections of the sanitary sewer line. During the RI, the site was redefined to consist of all the sewer lines on the Main Base that drained buildings where TCE was reported as stored or used (IT Corporation, 1993a) (Figure 2-1). Sampling from soil borings during the RI identified no significant contamination associated with Site OT-23. Additional RI work focused on the portions of the sanitary sewer line that were located above water table contamination (IT Corporation, 1996a). A sewer line flushing and soil gas survey project was conducted along the suspect lines, and although the results from the flush samples and nearby shallow soils did not indicate that the sewer line was a source of VOC contamination, the results from soil vapor samples collected from borings near the sewer lines suggested the sewer line was a source. On this basis, the Basewide OU ROD identifies four areas (Subsites OT-23A, -23B, -23C, and -23D) requiring remedial action (AFBCA 1998c). Subsite OT-23A was addressed by the SVE remedial action at Site LF-18 (Section 2.6.2), and Subsites OT-23B and OT-23D are addressed by the SVE remedial action at Site ST-37/ST-39/SS-54 (Section 2.4.2). The COCs identified at each of the subsites are: TCE at Subsite OT-23A and Subsite OT-23B; cis-1,2-DCE at Subsite OT-23B; and xylenes at Subsite OT-23D.

Site OT-23C was further defined in 1998, near the site of a former dry cleaning plant where a source of tetrachloroethene (PCE) contamination was found. The remedy selected in the Basewide OU ROD for Subsite 23C is SVE (AFBCA, 1998c). The SVE system for Site OT-23C was constructed in 1999 and has been operating since 2000.

An ESD, finalized in 2010, adds ICs to the remedy at Site OT-23C (AFRPA, 2010b).

In March 2011, the Air Force issued an OPS report for the Site OT-23C remedial action (AFRPA, 2011a); that report received EPA concurrence in July 2011 (EPA, 2011b).

2.6.4 Site OT-87

Site OT-87 was a skeet and trap range at Mather near the AC&W Site (Figure 2-1). It contained an area where clay pigeon fragments had accumulated, and an area of lead shot, which encompassed part of Morrison Creek. COCs in sediments at Site OT-87 include arsenic and lead; COCs in surface soil include lead and multiple semivolatile organic compounds (see Section 3.5). The remedial action selected in the Basewide OU ROD for Site OT-87 consists of excavation and backfill with clean soil, separation of lead shot, treatment of lead-containing soil, disposal of the treated soil at Site WP-07, and ICs (AFBCA, 1998c). The contaminated soil, clay pigeon material, and lead shot were excavated in 1998. The soil was processed to remove recoverable lead and stabilized with a cement additive for use in building the foundation for the Site WP-07 cap. An RAR was finalized in September 2009 (AFRPA, 2009b) and received EPA concurrence (EPA, 2009).

In addition, the Basewide OU ROD requires monitoring to ensure that the residual levels of lead left in place at Site OT-87 do not present a hazard to small mammals. To accomplish this goal, monitoring of lead levels in small mammal tissue was required on an annual basis for 3 years (if small mammal tissue lead levels are lower than those reported to cause adverse effects after a minimum of 2 years of monitoring, then monitoring will be discontinued upon agreement by the regulatory agencies), with the results evaluated in an annual monitoring report to the regulatory agencies (AFBCA, 1998c). The third year of monitoring was completed in 2009 (MWH, 2010c). Based on the monitoring results, the Air Force concluded that residual lead concentrations in soil do not indicate potential for adverse effects on small mammal populations and, therefore, discontinued small mammal monitoring at Site OT-87.

The Basewide OU ROD also requires evaluation of any dead waterfowl found at the site. Through September 2014, no dead waterfowl have been observed at Site OT-87.

The remedial action was conducted with a cleanup standard for lead that is consistent with recreational use. ICs are in place as part of the remedy to prevent human health risks from exposure to soils contaminated with lead. An ESD, finalized in 2010, clarifies the ICs and their implementation at Site OT-87 (AFRPA, 2010b).

2.7 OU 6 (Supplemental Basewide OU) Chronology

The Supplemental Basewide OU was established to address four IRP sites and an AOC that had not been addressed in previous Mather RODs. Sites SD-80, SD-85, and DD-88, all of which are drainage ditch sites, were initially investigated, evaluated, and proposed for remedial action in the Basewide OU RI and FFS (IT Corporation, 1996a; 1997b) and Basewide OU Proposed Plan (AFBCA, 1997b). At that time, the regulatory agencies noted that the extent of contamination (primarily pesticides, plus polycyclic aromatic hydrocarbons [PAHs], metals, and TPH at Site SD-85) at these sites was not adequately defined, toxicity tests were not conclusive, and consensus was not reached on cleanup levels; therefore, the sites were not included in the Basewide OU ROD. Consequently, additional site data were collected, and the sites were incorporated into the Supplemental Basewide OU. A newer IRP site (Site OT-89) and an AOC (the Suspected Ordnance Burial AOC) were included also in the Supplemental Basewide OU. These latter two were not part of the IRP when the Basewide OU was defined.

Excavation of contaminated sediment was conducted as part of removal actions for Sites SD-80, SD-85, DD-88, and OT-89 under the Air Force IRP and CERCLA programs (AFBCA, 1997c; 1999b; 2001a; 2001b; MWH, 2002a; 2002b). As part of a pilot study, lead shot was removed from soil at Site OT-89, and the soil was stabilized using the Site OT-87 (Basewide OU) treatment system (Montgomery Watson, 2000b).

The Supplemental Basewide OU FFS was finalized in September 2000 (IT Corporation, 2000), and the Proposed Plan was released to the public (AFBCA, 2000). The Supplemental Basewide OU ROD was finalized in September 2006 (AFRPA, 2006). Finalization of the Supplemental Basewide OU ROD was delayed to resolve disagreements regarding implementation of ICs. As a result of the removal actions, no further action is required at Sites SD-80, SD-85, and DD-88 (AFRPA, 2006). The selected remedy for the

Suspected Ordnance Disposal AOC is also no further action because site investigations did not identify site contamination or evidence of ordnance disposal at the AOC (EOD Technology, 1999; AFRPA, 2006). A brief summary of the remedial action selected for Site OT-89 is presented in Section 2.7.1, and in more detail in Sections 4.0 and 7.0. Figure 2-1 shows locations of the Supplemental Basewide OU sites.

2.7.1 Site OT-89

Site OT-89, known as the old trap range, is between the northeast end of the runway and the former base family housing area. Little information is available for the site; however, aerial photographs suggest that the range was operational during the 1940s and early 1950s. The site contained two semi-circular sets of firing stations and several support buildings removed during the 1950s.

At Site OT-89, the remedy selected in the Supplemental Basewide OU ROD is ICs because lead remains in soil at concentrations that do not allow for unrestricted use (AFRPA, 2006). Therefore, Site OT-89 requires a five-year review.

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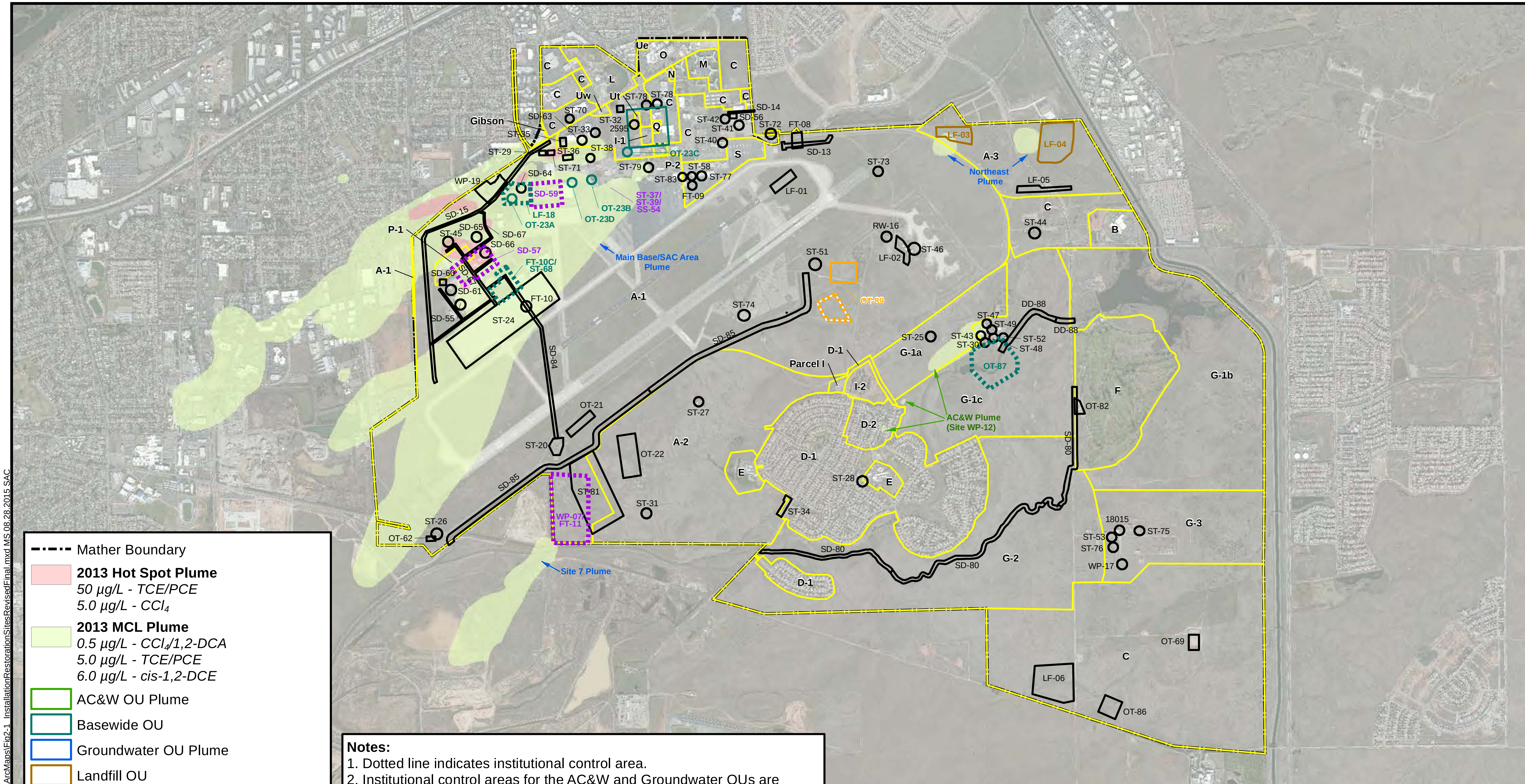


Mather Boundary

2013 Hot Spot Plume
50 µg/L - TCE/PCE
5.0 µg/L - CCl_4

2013 MCL Plume
0.5 µg/L - CCl_4/1,2-DCA
5.0 µg/L - TCE/PCE
6.0 µg/L - cis-1,2-DCE

AC&W OU Plume
Basewide OU
Groundwater OU Plume
Landfill OU
Soil OU
Supplemental Basewide OU
Other IRP Site That Does Not Require a Five-Year Review
Approximate Mather Parcel Boundaries

Notes:
1. Dotted line indicates institutional control area.
2. Institutional control areas for the AC&W and Groundwater OUs are shown on Figures 4-1 through 4-4.
3. The 2,000-foot groundwater plume boundary buffer (consultation zone) for the AC&W and Groundwater OU plumes is not shown but is updated each year and provided in the annual groundwater monitoring reports.
4. The 1,000-foot landfill institutional control buffer for Sites LF-03, LF-04, and WP-07 is shown on Figures 4-7, 4-11, and 4-12, respectively.

N
0 1,250 2,500
Feet
1 inch = 2,500 feet

URS

Installation Restoration Program Sites and Parcels

Former Mather Air Force Base
Sacramento County, California

Figure 2-1

L:\Projects\Mather\FiveYearReview\ArcMaps\Fig2-1_InstallationRestorationSitesRevisedFinal.mxd MS 08.28.2015 SAC

3.0 BACKGROUND INFORMATION ON MATHER

Mather Air Force Base (AFB) was constructed in 1918, primarily to serve as a flight training school. The base operated continuously as a training base for aviators from 1942 until 1993. This section describes activities that resulted in contamination at the facility and the physical characteristics that influence contaminant behavior and remediation. This section also describes the initial response actions taken prior to signing of the RODs and the results of risk evaluations.

3.1 Physical Characteristics

Mather is in the Sacramento Valley of Northern California (Figure 3-1). The former base is in Sacramento County, partially within the limits of the City of Rancho Cordova, a community that was incorporated in 2003. The north Mather boundary is approximately 0.25 mile south of U.S. Highway 50, a major highway connecting Sacramento and South Lake Tahoe. The former base encompassed approximately 5,845 acres at the time of closure in an unsurveyed part of Township 8 North, Ranges 6 East and 7 East.

3.1.1 Surface Water Hydrology

The original surface hydrology of the former Mather AFB consisted of ephemeral drainages (arroyos) and vernal pools. The entire base lies within the Morrison Creek watershed, which trends southwest across the base. Between the drainages, vernal pools occur where natural depressions, underlain by hardpan, collect surface runoff and store it in standing water or saturated soil for most of the spring and early summer. Modifications to the original surface hydrologic conditions at Mather include the construction of engineered drainage systems in and around developed areas, elimination of some vernal pools, creation of other seasonal wetlands (including some vernal pools) through grading and construction activities, and development of artificial surface-water bodies.

A prominent feature east of the base is the Folsom South Canal, which follows the entire length of the east base-boundary fence. Although five aqueducts cross the canal, development east of the canal has diverted much of the off-site surface flows originating in the upper (eastern) parts of the Morrison Creek watershed away from Mather. Discharge of treated groundwater upstream from Mather Lake has maintained the lake at full capacity since approximately 2005.

Engineered drainages channel runoff away from the main base and runway areas. The majority of the main base runoff flows into the West Ditch, which parallels the western base boundary as an unlined ditch. West Ditch runoff is channeled under the western end of the runway through a culvert and discharges into the South Ditch prior to flowing off of Mather. Lawn and landscape watering provide a small but constant flow of water into the West Ditch as well as into some of the channels draining the housing development to the South Ditch. Starting in September 2011, approximately 300 gallons per minute (gpm) of treated groundwater from the Main Base/SAC Area groundwater treatment plant was discharged into the West Ditch. As of 1Q14, the discharge rate had been increased to approximately 580 gpm. However, discharge to the West Ditch was suspended in April 2014 after several extraction wells were shut down and Sacramento County began using more of the treated groundwater for irrigation

The South Ditch is a long, unlined channel south of and parallel to the runways. It collects runoff from a small portion of the eastern part of the main base, the eastern part of the runways, and part of the housing development and routes it to a tributary channel off Morrison Creek at the southwest corner of the base. Runoff from the eastern portions of the main base and runways, as well as some off-base runoff, is directed to this channel through a culvert beneath the east end of the runway. Treated water from Aerojet-Rocketdyne and The Boeing Company groundwater treatment plants was discharged in 2013 at a rate of approximately 1,450 and 2,400 gpm, respectively, just upstream of the South Ditch.

Two artificially created water bodies are located along Morrison Creek. The larger, Mather Lake, is a 64-acre impoundment near the eastern boundary of the base. The smaller water body is an impoundment of approximately 1-acre on Morrison Creek, approximately 1 mile downstream of Mather Lake, near the former skeet-shooting range (Site OT-87). As of October 2014, the AC&W groundwater treatment plant discharges approximately 65 gpm of treated groundwater to Mather Lake; treated groundwater from another Boeing Company groundwater treatment plant was discharged in 2013 into Morrison Creek upstream of Mather Lake at a rate of approximately 420 gpm.

3.1.2 Regional Hydrogeology

Mather is situated in the northern half of the California Great (Central) Valley physiographic province. The former base is situated on ancient stream terraces south of the American River. The topography of Mather consists of three relatively flat terraces that step progressively lower toward the American River to the north, with elevations on each decreasing gently toward the southwest.

Groundwater in the eastern Sacramento area occurs in Oligocene or younger geologic formations that include thick deposits of fluvial sands and gravels. In the area of Mather, these sediments are present to a depth of approximately 900 feet below ground surface (bgs). Groundwater within these geologic units receives recharge from surficial stream flow and rainfall. Possible significant local recharge sources include the American River, Mather Lake, Morrison Creek, drainage ditches, and numerous settling or recycling ponds and excavations associated with gravel and sand mining operations south and west of Mather (Teichert Aggregates Company [Teichert] and Granite Construction Company [Granite]). Other potential sources of recharge are the sanitary and storm sewer lines on and near Mather, and flood detention basins, one northeast of Mather (west of LF-03) and one northwest (at the intersection of Systems Parkway and Routier Road). Former settling ponds northeast of Mather were in use in conjunction with aggregate mining by RMC Lonestar in the 1980s and 1990s, and appear to have been a significant source of recharge during that period.

Three geologic units are recognized at Mather (from youngest to oldest): the Terrace Gravels, the Laguna Formation, and the Mehrten Formation (Figure 3-2).

3.1.3 Site Geology and Groundwater Hydrology

Much of the shallow soil at Mather is fine-grained “hardpan” silt that serves as a barrier to infiltration of rainwater. There are areas of seasonal wetlands, many of which are vernal pools, supporting unique communities of plant and animal life. Beneath the hardpan are various layers of sediment that range in character from gravels to fine silts and clays.

The water table at Mather is generally encountered between 90 to 110 feet bgs in the Laguna Formation beneath the Riverbank Terrace deposits. The water table beneath Mather is encountered in Unit A, Unit B, or Unit C (defined below) (Figure 3-2). The coarse sands and gravels of Unit B of the Middle Laguna Formation, which have higher groundwater transmissivity than other subsurface units, are apparently continuous through the Main Base and SAC industrial areas, extending west beyond Mather. Consequently, these coarse sands and gravels, which allow relatively higher velocity groundwater flow, are important to the transport of contaminants dissolved in groundwater.

Groundwater beneath Mather flows westerly to southwesterly, conforming with the regional groundwater flow direction, and is locally influenced by supply well and extraction well pumping. Municipal and agricultural pumping in the region has created three groundwater “cones of depression” northwest, southwest, and south of Mather. The Elk Grove cone of depression to the southwest influences the general groundwater flow direction at Mather (Montgomery Watson, 1999b).

Functional Hydrostratigraphy at Mather. Four general hydrostratigraphic (HSG) units, A to D, are designated at Mather. Each of these units is described below and shown on Figure 3-2.

Because the water table slopes generally westward at a slightly lower angle than the westward dip of the HSG units, the water table beneath Mather transects Units A, B, and C progressively to the east (Figure 3-2 for the area north of the runways). Accordingly, the saturated thickness of the units decreases to the east. The water table occurs in Unit C near Sites LF-03 and LF-04. In general, Units A, C, and D are finer-grained, with A and D containing some coarser-grained channel deposits; Unit B north of the runways has generally coarser-grained sediments. South of the runways there is finer-grained lithology at roughly the same depths as Unit B; however, the fine-grained aquifer materials in this general depth range at Site 7 and AC&W are referred to as Unit C based on the lithology, rather than the time-equivalent depositional history. Unit D and the Mehrten Formation are saturated beneath the entire Mather property.

- Unit A (the water table occurs in Unit A in the western portion of Mather and west of Mather) corresponds with the Upper Laguna Formation and consists primarily of overbank deposits of silt and fine sand, but some channel-fill sand and gravel are also present. The sediments are fairly continuous across Mather, but are now mostly above the water table. In most areas, overbank deposits of Unit A overlie coarse sediment of Unit B, but locally, channel deposits from the two units are continuous from above the water table to the bottom of Unit B (Montgomery Watson, 1999b).

- Unit B corresponds with the Middle Laguna Formation and consists of coarse channel-fill deposits of sandy gravel beneath the Main Base/SAC Area, extending west of Mather. The deposits range in thickness from roughly 20 to 60 feet and are first encountered at depths of roughly 120 feet bgs in the east and 180 feet bgs in the west. In areas south of the runway (i.e., Site WP-07), the coarse sediments of Unit B transition laterally to finer-grained Unit C sediments. Generally, along eastern and central portions of Mather, Unit A is above the water table or absent, and groundwater is first encountered in Unit B or Unit C. Unit B is the most transmissive unit of the Laguna Formation in areas north of the runway and in areas where the Middle Laguna Formation is characterized by channel-fill deposits of sandy gravel. In the western portions of Mather and extending west off the base, Unit B is divided into two subunits, an upper channel subunit (Unit Bu) and a lower channel subunit (Unit B) (IT Corporation, 1996a). Unit Bu is only identified as a distinct unit where fine overbank deposits, referred to as the Unit Bu/B aquitard, are present. The Unit Bu/B aquitard is locally discontinuous; in some areas along the Mather boundary the aquitard is not present and Units Bu and B are indistinguishable, allowing effective vertical hydraulic communication throughout the Middle Unit of the Laguna Formation (Montgomery Watson, 1999b). For this reason, these subunits are grouped together for purposes of describing the nature and extent of COCs. Hydrogeologic Units Bu and B are important to the flow of groundwater and movement of COCs. Because of their high transmissivity, channel-fill deposits of Units Bu and B provide a preferential pathway for the flow of contaminated groundwater beneath and beyond Mather (IT Corporation, 1996a). Some wells screened in Unit B are further identified as representing relatively shallower Unit B (Bs) or deeper Unit B (Bd) but these do not indicate discrete lithologic units.

- Unit C is a portion of the Lower Laguna Formation and consists predominantly of silt and clay. Unit C is defined as the vertical interval between Unit B sands and gravels and the uppermost Unit D sands. Unit C may functionally constitute an aquitard because of its persistent extent and thickness and the significant differences in hydraulic head between units lying above and below it. Unit C as defined above is generally 10 to 50 feet thick throughout the area (Montgomery Watson, 1999b). The water table occurs in Unit C beneath relatively small portions of Mather near Sites LF-03, LF-04, Site WP-07, and the AC&W site. Fine-grained sediments at the AC&W and Site 7 areas are also defined as Unit C based on lithology, although they are at depths equivalent to Unit B gravels north of the runways.

- Unit D is the deeper portion of the Lower Laguna Formation and extends from the top of the uppermost sandy channel below Unit B to the beginning of the Laguna-Mehrten Transition (LMT). Unit D consists primarily of fine overbank deposits of silt and clay and a lesser number of coarse sandy channel deposits that are generally 20 to 40 feet thick. The unit behaves as a confined aquifer. Unit D channel deposits are encountered beneath Mather at approximately 220 to 300 feet bgs and are characterized by sands and silty sands, as opposed to the coarse sands and gravels of Unit B (Montgomery Watson, 1999b). Unit D sands are deeper to the west, as the base of Unit D is progressively deeper in that direction. Unit D is interpreted to be approximately 140 to 200 feet thick throughout the site. VOC contamination has been found in the upper to middle portions of Unit D.

- Underlying Unit D is a transition zone between the Laguna and Mehrten formations. The transition zone is characterized by materials derived from both andesitic and granitic source materials. The elevation of the top of the LMT Zone is interpreted to range from approximately 250 feet below mean sea level (msl) beneath the northwestern portion of Mather near the injection wells for the Main Base/SAC treatment system to approximately 380 feet below msl west of Mather near the Oaken Bucket water supply well (MWH, 2007a). There are several deep-nested monitoring wells installed and/or monitored by Aerojet-Rocketdyne in the upgradient portions of Mather to monitor deep-level VOC and perchlorate contamination associated with the Inactive Rancho Cordova Test Site plumes with sources hydraulically upgradient of Mather. These wells extend through the Laguna Formation, through the LMT, and several are completed in the underlying Mehrten Formation. Based on the HSG zonal classification of these wells provided by ENSR Consulting and Engineering (former consultant to The Boeing Company), the LMT in the upgradient portions of Mather (beneath the Northeast Perimeter Landfills) is between 70 and 130 feet thick. This thickness is corroborated by the lithologic descriptions in one of the deepest wells at Mather, MAFB-347, drilled to 530 feet and located on the northwest boundary of the Main Base/SAC Plume, southeast of the Oaken Bucket water supply well. Dark green to black andesitic grains are first noted on the log at approximately 375 feet bgs, which is interpreted to be the beginning of the LMT. Very dark gray andesitic sands are described beginning at about 490 feet bgs. Assuming this depth is near the top of the Mehrten Formation, the LMT would be approximately 120 feet thick at this location.

3.2 Land and Resource Use

Mather AFB was first activated in 1918 as a combat pilot training school and operated intermittently until the start of World War II when it operated as a pilot and navigator training post. After World War II, Mather AFB was the sole aerial navigation school for the United States military and its allies. On 30 September 1993, the base was decommissioned under the Base Realignment and Closure Act. Since its closure in September 1993, the former base has been in transition to civilian use, and by the end of 2013, transfer of nearly all of the Air Force property was complete. The remaining portions of two parcels are planned for transfer by the Department of the Interior to Sacramento County. Approximately one-half of the base has been transferred for use as a cargo-focused and general aviation airport. Approximately one-third of the base has been transferred for use as parkland, including an 18-hole golf course. The former military housing has been replaced by larger, single-family homes. Much of the rest of Mather has been transferred or sold for business development and government use. Land uses at Mather include a National Guard station, a Veterans Affairs hospital, two FAA radar facilities, two churches, and two elementary schools. Figure 2-1 shows the parcels transferred as of January 2014 or in the process of being transferred.

Land surrounding Mather is used for a variety of purposes, including agricultural, residential, commercial, and industrial uses. Residential developments lie to the north, east, and northwest of Mather adjacent to major retail centers and other businesses. This area includes schools and outdoor public recreation facilities. To the west are gravel processing, business office and industrial properties, and rural residences, although further west, land is used for more suburban residential and business purposes. Land to the southwest and south has been extensively excavated for gravel mining operations. Also south of Mather land is used for agricultural and some commercial activities. To the east and northeast, land use includes industrial with some agricultural areas and recently constructed residential developments.

There are several public water supply wells on and in the vicinity of Mather. Five former base water supply wells in the former housing area are now owned and controlled by Sacramento County Water Agency (SCWA). Four former base water supply wells (MB-1, MB-2, MB-3, and MB-4) in the northern part of Mather also owned and controlled by SCWA were decommissioned in 2012. Water supply wells located off base to the east and west are owned by SCWA and the California American Water Company (Cal Am); some water supply wells to the north are owned by Golden State Water Company. Since 1998 and with two subsequent revisions, the *Mather AFB Off-Base Water Supply Contingency Plan* (Contingency Plan) has been in place, providing the strategy to address the impact or threat of impact to public water supply wells from groundwater contamination migrating to the west and off of Mather property (AFBCA, 1998e; AFRPA, 2008c; AFCEC, 2013). The Contingency Plan is required by the Soil OU and Groundwater OU ROD (AFBCA, 1996a). Groundwater contamination was also detected in several private domestic and irrigation wells to the west of Mather. These wells are no longer used for drinking water, and the contamination is not considered to imminently threaten any public or private drinking water wells. Bottled water was initially provided in the 1980s to residents whose water had contamination exceeding state action levels. These residences were later connected to either the Mather water supply or the Citizens Utilities Company (now Cal Am) water supply. For the first time in 2009, groundwater samples were collected from private water wells south and west from the Southwest Lobe of the Main Base/SAC Area Plume (Figure 2-1). Monitoring of these wells has been ongoing to provide assurance that the plumes are not continuing to migrate toward private drinking water wells.

3.3 History of Contamination

Military activities took place at Mather between 1918 and 1993. Fulfillment of the military missions involved the use and generation of a wide range of toxic and hazardous chemicals and substances, including industrial chemicals (e.g., chlorinated solvents), aviation fuels, and a variety of oils and lubricants. The use and disposal of these chemicals resulted in contamination of soil and groundwater at many locations at Mather through a variety of migration processes. For example, chlorinated solvents (VOCs) may have migrated downward through the soil column via separate phase liquid or dissolved in percolating surface water.

In addition, landfills were operated at Mather for the disposal of garbage and trash generated on base. Much of this was household waste, including household hazardous waste; however, industrial waste that was generated also may have been taken to these landfills. A dry cleaning plant was located at Mather in the 1950s and 1960s, and discharges from the plant to the sanitary sewer apparently leaked into soil. Contaminants dissolved in groundwater have migrated more than 2 miles beyond Mather's western boundary. The routine application of pesticides resulted in contamination of sediments. Aviation and other fuels stored in tanks and conveyed in pipelines leaked hydrocarbons into the soil. VOCs also entered soil vapor in soil pores above the water table. As environmental awareness and regulation increased in the 1970s and 1980s, the Air Force mobilized to change the practices that caused release of contamination into the environment and to address contamination that had resulted from past practices.

3.4 Initial Responses

Environmental studies have been underway at Mather since 1979 when groundwater contamination (TCE) was first detected in the water supply well serving the AC&W area. The IRP began in 1982 and identified locations at Mather where hazardous substances or other pollutants might have been released to the environment. These investigations confirmed the presence of VOCs and other hydrocarbons at several of the IRP sites. Based on this evidence, the AC&W Site was listed on the Superfund (CERCLA) National Priorities List (NPL) in 1987, and the entire base was placed on the NPL on 21 November 1989. In July 1989, the Air Force, EPA, and State of California signed the FFA for Mather (Air Force, 1989) under CERCLA §120 to ensure that environmental impacts from past and present operations are thoroughly investigated and appropriate cleanup actions are taken to protect human health, welfare, and the environment (Air Force, 1989). The FFA sets enforceable deadlines for documents, defines roles and responsibilities of each signatory party, and provides a vehicle for dispute resolution. The Air Force is the owner (or past owner) of the site, the principal responsible party, and lead agency for conducting investigative and cleanup activities. There have been no CERCLA enforcement actions related to any of the sites at Mather.

For some IRP sites, cleanup activities were conducted prior to a final remedial action being authorized by a signed ROD. Several removal actions were conducted as either time-critical (e.g., Sites LF-02 and FT-10C) or non-time critical (e.g., Sites ST-20 [evaluated via an engineering evaluation/cost analysis], SD-80, SD-85, DD-88, and OT-89). The time-critical removal actions were conducted to allow for excavation and consolidation of waste into Site LF-04 (AFBCA, 1996c; 1996d). The non-time critical actions were used to take early actions (IT Corporation, 1994b; AFBCA, 1997c; 1999b; 2001a; 2001b; MWH, 2002a; 2002b). The decision and authorization to conduct a removal action is documented in a removal action memorandum rather than a ROD, although the final remedy (and cleanup standards, if further action is necessary) is then selected in a ROD.

In addition, in situ pilot studies (SVE/BV) were conducted at Sites FT-10C/ST-68, OT-23, LF-18, ST-39, SD-57, and SD-59 to determine whether in situ remediation technologies were feasible at those sites (EA Engineering, 1997; IT Corporation, 1995a; 1996b; Montgomery Watson, 1999a). A pilot study was conducted at Site OT-89 during the remedial action for Site OT-87 (Basewide OU) to determine whether the soil from Site OT-89, containing lead shot, could be successfully treated using the same stabilization technology implemented at Site OT-87 for the soil there (Montgomery Watson, 2000b).

3.5 Basis for Taking Action

Exposure to concentrations of contaminants in soil, sediment, surface water, and/or groundwater may pose an unacceptable human health and/or ecological risk. Cleanup is required for contaminant concentrations that exceed promulgated thresholds, or for which concentrations exceed risk-management criteria developed or accepted by the regulatory agencies and the Air Force. The over-riding basis for cleanup at Mather is protection of human health and the environment, as required by CERCLA.

A comprehensive baseline risk assessment (CBRA), including human health and ecological risk assessments, was completed in 1996 for 85 IRP sites (IT Corporation, 1996c). Chemicals of potential concern for human health and ecological risk included solvents, fuel constituents, chlorinated pesticides, PAHs, polychlorinated biphenyls, dioxins/furans, metals, and explosive residues. The CBRA quantified the potential impacts on human health and the environment for a no remedial action scenario. Potentially exposed human populations included then-current on-base workers, future on-base workers, and future on-base and off-base residents. Potentially exposed base environments included vegetation, wildlife, and aquatic organisms associated with 18 IRP sites, each exhibiting completed exposure pathways, and related drainage areas. The risk estimates in the CBRA are considered highly conservative and protective of potentially exposed human and ecological populations as described in the current and future land-use scenarios (IT Corporation, 1996c). Equally conservative human health and ecological risk assessments were conducted for IRP sites that were identified after the CBRA was completed, including Sites OT-86 and OT-87 (AFBCA, 1998c) and SD-80, SD-85, DD-88, and OT-89 (IT Corporation, 2000).

Environmental contaminants requiring cleanup at Mather have been discovered in soil, sediment, surface water, and groundwater. Table 3-1 provides a list of COCs and cleanup levels for each site requiring a five-year review. COCs and cleanup levels for each site are established in the various RODs and/or ESDs.

Table 3-1. COCs and Cleanup Levels for Mather IRP Sites Requiring a Five-Year Review

IRP Site Number	COCs	Cleanup Level
LF-03	NA	NA
LF-04	NA	NA
WP-07/FT-11	**Subsurface Soil**	
	TPH as diesel	Narrative[a]
	TPH as gasoline	Narrative[a]
FT-10C	**Subsurface Soil**	
	Carbon tetrachloride	Narrative
	Benzene	Narrative
	Toluene	Narrative
	Ethylbenzene	Narrative
	Xylenes	Narrative
	TPH as diesel	Narrative[b]
	TPH as gasoline	Narrative[b]
ST-68	**Subsurface Soil**	
	TPH as gasoline	Narrative
FT-10C/ST-68	**Soil**	**mg/kg and mg/L**
	Lead	800 mg/kg (industrial use)
	Lead	151 mg/kg (unrestricted)
	Lead	15 mg/L (soluble)
WP-12 (AC&W Plume)	**Groundwater**	**µg/L**
	Trichloroethene	5
LF-18	**Subsurface Soil**	
	Trichloroethene	Narrative
	1,2-Dichloroethene	Narrative
OT-23	**Subsurface Soil**	
	Tetrachloroethene	Narrative
	Trichloroethene	Narrative
	1,2-Dichloroethene	Narrative
	Xylenes	Narrative
ST-37	**Subsurface Soil**	
	TPH as diesel	Narrative[a]
	TPH as gasoline	Narrative[a]
	Oil and grease	Narrative[a]

Table 3-1. (Continued)

IRP Site Number	COCs	Cleanup Level
ST-39	**Surface Soil**	
	TPH as diesel	Narrative[a]
	Oil and grease	Narrative[a]
	Subsurface Soil	Narrative[a]
	Benzene	Narrative[a]
	Ethylbenzene	Narrative[a]
	Toluene	Narrative[a]
	Xylene	Narrative[a]
	TPH as diesel	Narrative[a]
	TPH as gasoline	Narrative[a]
SS-54	**Subsurface Soil**	
	Benzene	Narrative[a]
	TPH as gasoline	Narrative[a]
SD-57	**Subsurface Soil**	
	Trichloroethene	Narrative
SD-59	**Subsurface Soil**	
	TPH as diesel	Narrative[a]
	TPH as gasoline	Narrative[a]
OT-87	**Sediments (and pellet removal)**	**ppm**
	Arsenic	9.6
	Lead	15.5
	Surface Soil	**ppm**
	Lead	700
	Benzo(a)pyrene	0.33
	Benzo(g,h,i)perylene	0.33
	Dibenzo(a,h)anthracene	0.33
	Fluoranthene	0.33
	Phenanthrene	0.33
OT-89	**Soil**	
	Lead[c]	NA[c]
Main Base/SAC Area Plume	**Groundwater**	**µg/L**
	Tetrachloroethene	5
	Trichloroethene	5
	1,1-Dichloroethene	6
	cis-1,2-Dichloroethene	6
	1,2-Dichloroethane	0.5
	Carbon tetrachloride	0.5
	TPH as diesel	100
	TPH as gasoline	50
	Benzene	1
	Xylenes	17
	Chloromethane	3
	Lead	15
Northeast Plume	**Groundwater**	**µg/L**
	Tetrachloroethene	5
	cis-1,2-Dichloroethene	6
	Carbon tetrachloride	0.5
	Chloromethane	3
	1,2-Dichloropropane	5

Table 3-1. (Continued)

IRP Site Number	COCs	Cleanup Level
Site 7 Plume	**Groundwater**	**µg/L**
	Tetrachloroethene	5
	Trichloroethene	5
	1,1-Dichloroethene	6
	cis-1,2-Dichloroethene	6
	Vinyl chloride	0.5
	1,2-Dichloroethane	0.5
	1,4-Dichlorobenzene	5
	Benzene	1
	Chloromethane	3
	TPH as diesel	100

[a] Numeric soil cleanup levels replaced with narrative soil cleanup levels in the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a).

[b] Numeric soil cleanup levels replaced with narrative soil cleanup levels in the 2010 Basewide OU ESD (AFRPA, 2010b).

[c] 192 ppm lead is a threshold concentration above which land-use restrictions apply for Site OT-89 (AFRPA, 2006). In addition, remedial action objectives (which would apply to any future excavation) are to prevent plant exposure to concentrations above 700 mg/kg and prevent disturbance of subsurface soil that could threaten water quality.

AC&W = Aircraft Control and Warning
AFRPA = Air Force Real Property Agency
COC = contaminant of concern
ESD = explanation of significant difference
FT = fire training
IRP = Installation Restoration Program
LF = landfill
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
NA = not applicable
OT = other
OU = operable unit
ppm = parts per million
SAC = Strategic Air Command
SD = storm drain
SS = sanitary sewer
ST = storage tank
TPH = total petroleum hydrocarbons
WP = waste pit
µg/L = micrograms per liter

For all sites listed in Table 3-1 that have narrative soil cleanup levels established in the Soil OU and Groundwater OU ROD or ESD or Basewide OU ROD or ESD (AFBCA, 1996a; 1998c; AFRPA, 2010a; 2010b), the following apply:

The goal of cleaning up the vadose zone is to minimize further degradation of the groundwater by the contaminants in the soil. It is generally preferable from a technical and cost perspective to clean up contamination in the vadose zone before it reaches the groundwater. The soil cleanup standard will be achieved when the residual vadose zone contaminants will not cause the groundwater cleanup standard, as measured in groundwater wells monitoring the plume, to be exceeded after the cessation of the groundwater remediation. The Air Force will make the demonstration that the standard has been met through contaminant fate-and-transport modeling, trend analysis, mass balance, and/or other means. This demonstration will include examination of the effects of the residual vadose zone contamination in the groundwater using VLEACH or another appropriate vadose zone model, in conjunction with a groundwater fate-and-transport model, to predict the resulting concentration from this residual vadose zone contamination in the nearest groundwater wells monitoring the site.

This demonstration can be made prior to the cessation of groundwater remediation. The Air Force shall provide verification, through data, that the above standard has been met. The signatory parties to the RODs will jointly make the decision that the soil cleanup standard has been met.

The Air Force shall operate the SVE system until it makes the demonstration that the cleanup standard, set forth above, has been met. The Air Force shall continue to operate the SVE system, if appropriate, after considering the following factors:

a) Whether the predicted concentration of the leachate from the vadose zone (using VLEACH or another appropriate vadose zone model that interprets soil gas data) will exceed the groundwater cleanup standard

b) Whether the mass removal rate is approaching asymptotic levels after temporary shutdown periods and appropriate optimization of the SVE system

c) The additional cost of continuing to operate the SVE system at concentrations approaching asymptotic mass levels

d) The predicted effectiveness and cost of further enhancements to the SVE system (e.g., additional vapor extraction wells)

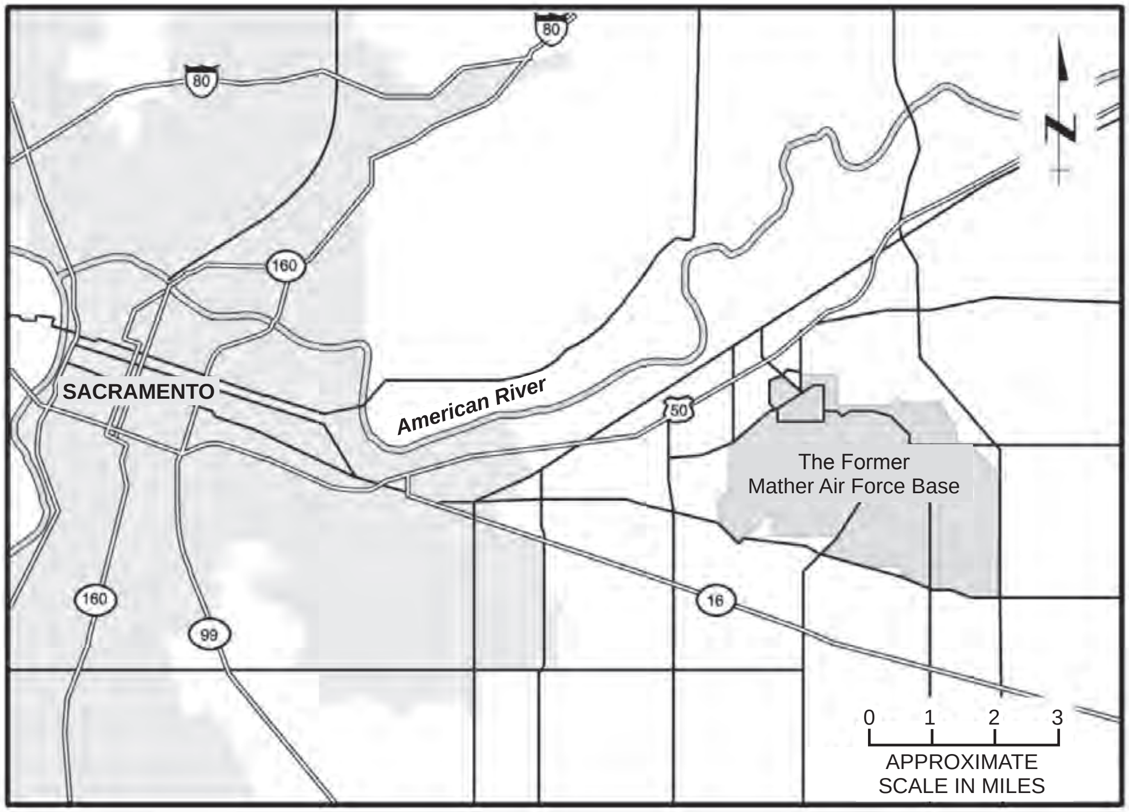
e) Whether the cost of groundwater remediation will be significantly more if the residual vadose zone contamination is not addressed

f) Whether residual mass in the vadose zone will significantly prolong the time to attain the groundwater cleanup standard

g) The incremental cost over time of vadose zone remediation compared to the incremental cost over time for groundwater remediation on the basis of a common unit (e.g., cost per pound of TCE removed) provided that the underlying groundwater has not reached aquifer cleanup levels

The signatory parties agree that the Air Force may cycle the SVE system on and off to optimize SVE operation and/or to evaluate the factors listed above.

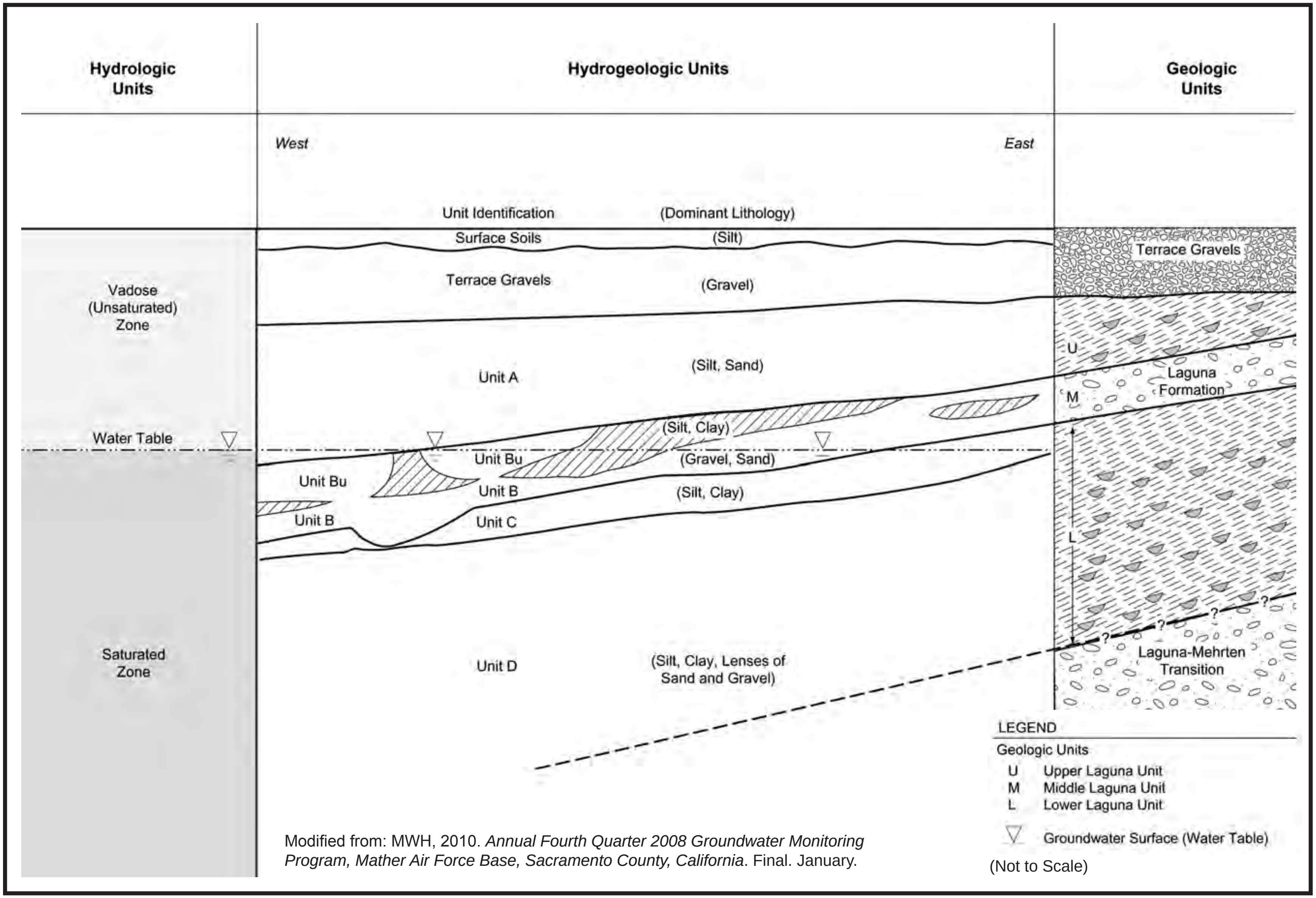
Once SVE is terminated in accordance with the demonstration described in the preceding paragraphs, the Air Force will re-evaluate the need to implement bioventing.



Modified from: MWH, 2010. *Annual Fourth Quarter 2009 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.

H:\Graphics\Mather\5 Year Review\08-15-Mather-Loc-Map.indd - VMG 08/28/15 SAC

Figure 3-1. Regional Location Map, Former Mather Air Force Base, Sacramento County, California



Modified from: MWH, 2010. *Annual Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.

Figure 3-2. Generalized Hydrogeologic Cross-Section North of Runways, Former Mather Air Force Base, Sacramento County, California

4.0 REMEDIAL ACTIONS

This section describes the remedial actions taken at Mather in accordance with the five RODs. This section identifies the RAOs for each site requiring a five-year review, describes the selected remedies and their implementation, and discusses system operation and maintenance (O&M).

4.1 Groundwater Remedies

4.1.1 OU 1 (AC&W OU)

Remedy Selection. The AC&W OU ROD was signed in December 1993 by AFBCA, EPA, and DTSC to address contaminated groundwater at Site WP-12 (AC&W Site) at Mather. The RAOs identified in the AC&W OU ROD are to remove contaminant mass from the groundwater plume and remediate the plume to the ACL of 5 μg/L for TCE, comply with the discharge standard for disposing of the treated water, and comply with air emission requirements (AFBCA, 1993).

The selected remedy for the AC&W Plume includes groundwater extraction and air stripping with on-site injection of treated water (effluent) into the aquifer. The discharge component of the remedy was modified via an ESD to surface water discharge into Mather Lake (AFBCA, 1997a). In addition, the remedy includes vapor-phase carbon adsorption of TCE from the stripped vapor, if required to meet Sacramento Metropolitan Air Quality Management District (SMAQMD) ARARs, and off-site regeneration of spent activated carbon, if necessary.

In 2008, ICs were added to the AC&W OU groundwater remedy through a second ESD (AFRPA, 2008a). The cleanup remedy selected in the AC&W OU ROD did not include ICs to prevent exposure to groundwater or to protect the remedial system components, although the Air Force implemented land-use restrictions for these purposes through land ownership and later lease and deed restrictions. The 2008 ESD includes temporary groundwater use restrictions as a component of the AC&W groundwater remedial action until the ACL for TCE is met for the AC&W groundwater plume.

The RAOs for the ICs are: (1) preventing human exposure to groundwater with concentrations of TCE exceeding the ACL of 5 μg/L; (2) protecting the integrity of the remedial system, including the associated monitoring system; and (3) protecting necessary access to the remedial system, including the associated monitoring system.

The specific ICs have been documented as environmental restrictive covenants in deeds for the parcels associated with Site WP-12 that have been transferred from Air Force ownership and in restrictions/ prohibitions in a state land use covenant (SLUC) for Parcel G-1a (Figure 2-1). The transferee is prohibited from:

- Installing any wells for the extraction of groundwater from affected properties for any purpose other than remediation or monitoring
- Constructing or creating any groundwater recharge area, unlined surface impoundments, or disposal trenches that cause the alteration of groundwater conditions
- Conducting or allowing others to conduct activities that would cause disturbance of any systems, equipment, or components of systems associated with groundwater remediation or monitoring
- Conducting or allowing others to conduct activities that would limit access to any systems, equipment, or components of systems associated with groundwater remediation or monitoring

Remedy Implementation. The pump-and-treat system for the AC&W OU began operating in January 1995. The original groundwater extraction and treatment system for the AC&W Plume consisted of eight extraction wells, a packed tower air stripper, an effluent tank, and eight injection wells. A pipeline that discharges treated water from the AC&W treatment system to Mather Lake was later constructed, and the injection wells have not been used since 1997. The injection wells were decommissioned in 2009 (MWH, 2009a). Vapor-phase carbon adsorption of contaminants from the stripped vapor was not required because emission rates did not exceed the SMAQMD limit of 2 pounds per day (lbs/day) above which treatment would be required.

Six extraction wells (ACW AT-1 and AT-2, ACW EW-1, EW-2, EW-3, and EW-6R) operated during part or all of 2013 (Figure 4-1) producing a combined average influent flow rate of approximately 105 gpm when all six wells were operating. In September 2013, ACW EW-2 was shut down because TCE concentrations had been less than the ACL since 2Q08, and the hydraulic effect of operating this well was reducing the effectiveness of extraction at ACW EW-1 and ACW EW-3. ACW EW-6R was shut down in August 2013 because TCE concentrations had been less than the ACL since 2011. However, the well was restarted in December 2013 because the TCE concentration in the first sample collected after shutdown exceeded the ACL, and because this AC&W OU extraction well is the farthest downgradient. In July 2014, ACW EW-3 was shut down because TCE concentrations had been less than the ACL since 2009, TCE concentrations in nearby monitoring wells were less than the ACL, and shutdown of the well would not allow contamination greater than the ACL to escape capture.

During the period of this five-year review, two extraction wells were decommissioned. TCE concentrations at ACW EW-4 were less than the ACL from 2006 through 2009, and the well was turned off in February 2010. No concentration rebound was observed in samples collected from this well between 1Q10 and 2Q12. ACW EW-5 was shut down in 2000, and TCE was not detected in samples collected from this well between 2002 and 2006, when sampling was discontinued. ACW EW-4 and ACW EW-5 were decommissioned in 2013 (URS, 2013a).

During the period of this five-year review, IC inspections were conducted four times to ensure that ICs are maintained and enforced:

- In 2010, covering the period November 2008 through August 2010 (AFRPA, 2010c)
- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2013, covering all of 2013 (AFCEC, 2014),

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections, with one exception. On 29 December 2012, the fence surrounding the AC&W groundwater treatment system was cut by vandals, and the remedial system was extensively damaged, resulting in the system being offline until 15 March 2013. Subsequently, security upgrades were implemented at the AC&W groundwater treatment system, as well as at the other remedial systems site wide. Figure 4-1 shows the area of the AC&W OU requiring ICs per the 2008 ESD (AFRPA, 2008a). However, per the deed for Parcel G-1a and the letter of assignment for Parcel G-1c, the ICs for the AC&W OU have been (G-1a) or will be (G-1c) applied to the entire parcel area (see Figure 2-1 for the parcel boundaries). For Parcel I-2, the IC area required by the 2008 ESD (AFRPA, 2008a) coincides with the parcel area.

As of October 2014, three of the four parcels associated with Site WP-12 ICs had been transferred from Air Force ownership, and the deed restriction language in the 2008 ESD (AFRPA, 2008a) was included in the deeds. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deeds. In January 2014, a SLUC was executed for one parcel (G-1a); therefore, the new property owner is required to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. One other parcel (G-1c) was assigned to, and accepted by, the United States Department of the Interior (DOI) in January 2013 but had not yet been transferred to Sacramento County as of October 2014. For the other two parcels (G-1b and I-2), no SLUC is planned. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer.

4.1.2 OU 2 (Groundwater OU) – Main Base/SAC Area Plume

The Soil OU and Groundwater OU ROD was signed in 1996 by AFBCA, EPA, and DTSC to address contaminated groundwater in the Main Base/SAC Industrial Area, Site 7, and Northeast Plume areas. For the purpose of selecting a remedial alternative, the Soil OU and Groundwater OU ROD combined the Main Base and SAC Industrial Area Plumes. The remedy selected for the Main Base/SAC Area Plume and its implementation are described below. Remedy selection and implementation for the Site 7 and Northeast Plumes are described in Sections 4.1.3 and 4.1.4, respectively.

Remedy Selection. The RAOs identified in the Soil OU and Groundwater OU ROD for the Main Base/SAC Area Plume are to achieve the ACLs throughout the contaminated aquifer, and comply with the discharge standards for disposing of the treated water. In addition, the remedial action calls for land-use restrictions on Air Force property, as appropriate, and groundwater monitoring.

The remedial action selected in the Soil OU and Groundwater OU ROD for the Main Base/SAC Area Plume is groundwater extraction and treatment with the following components:

- A phased implementation program
- Groundwater extraction, to achieve ACLs, estimated at but not limited to a total rate of 1,300 gpm
- Treatment of the extracted groundwater through air stripping with off-gas treatment (i.e., carbon adsorption) to achieve ACLs (see Table 3-1) and to achieve discharge standards (for treated water and offgas)
- Groundwater injection in compliance with discharge standards (see Table 6-7, AFBCA, 1996b), in combination with other discharge options (to be evaluated during remedial design) that are (a) consistent with attainment of cleanup standards, and (b) cost-effective
- Land-use restrictions implemented on Air Force property as appropriate, to preclude installation of groundwater wells that would not be compatible with protection of public health and the environment
- Groundwater monitoring

An ESD, finalized in 2010, clarifies the next-to-last bullet item above with respect to the implementation of land-use restrictions on Air Force property, and establishes additional ICs to protect the remedial system components and to preclude any activities that are inconsistent with the remedial actions or access to the remedial system components (AFRPA, 2010a).

The RAOs for the ICs are: (1) preventing human exposure to groundwater with concentrations exceeding the ACLs that are specified in the Soil OU and Groundwater OU ROD; (2) protecting the integrity of the groundwater remedial actions and systems, including the associated monitoring systems; and

(3) preserving access for the Air Force, EPA, and the State of California to the site, the remedial systems, and associated monitoring systems.

The specific ICs have been documented as environmental restrictive covenants in deeds and restrictions/ prohibitions in SLUCs for the parcels associated with the Main Base/SAC Area Plume that have been transferred from Air Force ownership. The transferee is prohibited from:

- Damaging/disturbing/tampering with, or allowing others to damage/disturb/tamper with, the remediation system components, including but not limited to the extraction and injection systems, treatment systems, conveyance pipes, electrical, gas, or fiber optic lines, or monitoring wells, until such time as remediation is complete or components are no longer to be used for remediation

- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of any remediation system component

- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to the site or to any equipment or component associated with the groundwater remediation systems

- Conducting, or allowing others to conduct, any surface activities that introduce or allow infiltration of water/other fluids into the groundwater (e.g., construction/creation of any groundwater recharge area, percolation ponds, unlined surface impoundments/trenches, or irrigation for agricultural purposes), unless specifically approved in writing by the Air Force, EPA, and the State of California

- Installing wells or extracting groundwater, or allowing others to install wells or extract groundwater, for any purpose other than remediation or monitoring

In addition, the Soil OU and Groundwater OU ROD requires the development of a Mather-specific, off-base water supply contingency plan, which applies to contaminants from the Main Base/SAC Area Plume (AFBCA, 1996a). The Contingency Plan describes the Air Force’s plan for addressing the impact or the threat of impact to public water supply wells from groundwater contamination migrating from Mather. Key elements of the Contingency Plan include:

- Determining which wells likely will be affected

- Providing an ongoing monitoring plan of supply wells and their guard wells, including increased frequency of sampling once a constituent from the plume has been detected

- Determining the impact of supply well pumping on the plume(s) and recommend action(s) to minimize plume migration

- Evaluating the short-term and long-term options for providing alternate water supplies (the evaluation shall consider the technical effectiveness in dealing with the health threat, implementation time frame, cost, and acceptability to the water purveyor)

- Proposing a preferred alternative, including an implementation time schedule, which should address the sequencing of alternate remedies if the final solution is to include short-term and long-term solutions

- Developing a “trigger” for ascertaining when option(s) should be implemented

- Proposing measures and an implementation schedule to mitigate the vertical migration of contaminants to deeper aquifer zones for each well likely to be impacted by the plume

- Determining when the monitoring can be terminated

The original Contingency Plan was finalized in February 1998 (AFBCA, 1998e). Two subsequent revisions, each which supersede the prior version, were finalized in November 2008 (AFRPA, 2008c) and July 2013 (AFCEC, 2013).

Remedy Implementation. The Main Base/SAC Area Plume remedial system is installed and has been operating since 1998. Carbon adsorption of contaminants in the stripped vapor was not required because emission rates did not exceed risk-based levels or emission rates specified in the ARARs. Construction of the first phase (Phase I) of the groundwater extraction and treatment system for the Main Base/SAC Area Plume was completed in early spring 1998. The Main Base/SAC Area system began continuous operation in April 1998. Phase I of groundwater remediation of the Main Base/SAC Area Plume emphasized mass removal from hot spots in the Main Base/SAC Area Plume that were identified on Mather property. A hot spot is defined as an area having contaminant concentrations at least 10 times the ACL. Twelve extraction wells were initially installed as part of the Phase I Main Base/SAC Area treatment system.

The initial Phase II/III system expansion, completed in January 2000, added 12 more extraction wells to the system. The Phase II wells were installed in hot spots that extended beyond the Mather property boundary, and the Phase III extraction wells were installed to more aggressively remediate groundwater near source areas at Mather, particularly at Sites OT-23C and SD-57. During 2Q01, three additional Phase III extraction wells were installed to complete the Phase III system expansion. The three new extraction wells were brought online during 3Q01.

During 2Q02, eight extraction wells were installed as part of the Phase IV expansion of the Main Base/SAC Area remedial action. The objective of the Phase IV expansion was to augment the existing extraction system, primarily in the off-base portions of the Main Base/SAC Area Plume, and to increase the area of hydraulic capture imparted by the extraction wells installed under the previous three groundwater remediation phases. The Phase IV extraction wells were brought online in September 2002. Two additional extraction wells, addressing capture of the off-base leading edges of the plume to the west and southwest of the Main Base/SAC Area, began operating in 2005 and 2008, respectively. Also, because of decreasing water levels in groundwater at two existing Phase I extraction well locations, those two wells were replaced in 2005 by two new extraction wells with deeper screen intervals adjacent to the existing wells.

In 2008, MBS EW-1Bu, MBS EW-6ABu, MBS EW-7ABu, MBS EW-8B, and MBS EW-12AB were recommended for shutdown because the wells had more than four consecutive sampling events with COC detections less than ACLs and were no longer contributing to the capture of significant portions of the plume (MWH, 2010d). MBS EW-6ABu, MBS EW-7ABu, MBS EW-8B, and MBS EW-12AB were turned off in February 2010, but MBS EW-1Bu was not shut down. Even though COC concentrations have been less than ACLs since 2005, MBS EW-7ABu was restarted in 2013 to help capture COC mass in the area of MAFB-405, where COC concentrations were increasing.

During 2013, the following Main Base/SAC Area extraction wells, organized by HSG Unit, operated at a combined average influent flow rate of approximately 1,480 gpm:

- Extraction wells screened across the water table and HSG Unit Bu: EW-1ABu, EW-1Bu, EW-2AR, EW-2ABu, EW-4ABu, EW-4Bu, EW-5ABu, EW-7ABu, and EW-39ABuB.

- HSG Unit Bu/B: EW-1B, EW-2B, EW-3B, EW-4B, EW-5B, EW-6B, EW-7B, EW-9B, EW-10B, EW-11B, EW-12B, and EW-13BuB.

- HSG Unit D: EW-1D, EW-2D, EW-3D, EW-4D, EW-5D, and EW-6D.

The following wells are no longer used for extraction and did not operate in 2013: MBS 39EW02, MBS 19EW01, MBS EW-1A (replaced by MBS EW-7ABu), MBS EW-2A (replaced by EW-2AR), MBS EW-3A, MBS EW-3Bu, MBS EW-4A, MBS EW-5A, MBS EW-6ABu, MBS EW-8B, and MBS EW-12AB.

Figure 4-2 shows the layout of the groundwater extraction and treatment system for the Main Base/SAC Area Plume as of 30 September 2014, including 23 operating and 15 non-operating extraction wells (MBS EW-1B, MBS EW-4B, MBS EW-5B, and MBS EW-6B were shut down in March 2014 [see Section 7.3.1.1]), 4 injection wells, and conveyance piping.

Until September 2011, all extracted and treated groundwater was injected into the aquifer using injection wells, except for a limited quantity used by Sacramento County for irrigation of roadside landscaping at Mather. However, due to limited injection well capacity caused by recurring O&M issues, the Air Force proposed a supplemental method of discharging treated groundwater by adding surface water discharge into the nearby West Ditch that ultimately flows to Morrison Creek, a tributary to the Sacramento-San Joaquin River Delta. A modification of the Soil OU and Groundwater OU ROD was not required because the ROD authorized other discharge options.

Discharge of approximately 300 gpm of treated groundwater to Morrison Creek via the West Ditch began on 1 September 2011 in accordance with Soil OU and Groundwater OU ROD ARARs (AFBCA, 1996a). In 2012, the Air Force notified CVWB of its intent to increase the monthly average discharge rate to up to 1,000 gpm to maintain optimal remediation system performance, because the surface water discharge had increased from approximately 300 to 500 gpm to keep the groundwater treatment system running with all necessary extraction wells operating and to avoid treatment plant shutdowns (URS, 2012c). As of 1Q14, approximately 580 gpm of treated groundwater was discharged to the West Ditch. However, discharge was suspended to the West Ditch in April 2014 after several extraction wells were shut down and Sacramento County began using additional water for irrigation during this dry year.

In accordance with the Soil OU and Groundwater OU ROD, land-use restrictions prohibiting or requiring approval for any groundwater well construction on Air Force property were implemented through direct Air Force control prior to property transfer through conditions of leases and through deed restrictions where property has been deeded for all property overlying Groundwater OU contamination. No land-use restrictions have been applied under CERCLA where the Groundwater OU plumes underlie off-base property. However, in 2002, Sacramento County adopted a revised ordinance (County Code Chapter 6.28) that governs drilling of wells within 2,000 feet of any known groundwater contamination. Any permit application to drill or modify a well within this zone requires CVWB consultation prior to the issuing of any well permits. This revised ordinance allows recommendations to the county regarding their permitting choices: to approve, approve with conditions, or deny approval for each permit application. An ESD, finalized in 2010, clarifies the Groundwater OU land-use restrictions with respect to their implementation and adds ICs to protect the remedial system components and to preclude any activities that are inconsistent with the remedial actions or access to the remedial system components (AFRPA, 2010a).

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)

- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. Figure 4-2 shows the area of the Main Base/SAC Area Plume requiring ICs.

As of January 2013, all of the parcels that are or were associated with the Main Base/SAC Area Plume (A-1, A-1a, C2-C6, C-3, C-5, I-1, P-1, P-2, Q, Ut, and Uw) had been transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deeds. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deeds. For those parcels where a SLUC is planned or was executed, the new property owner will be or is required to conduct annual IC inspections and to report on those inspections to the state until the ICs at the site are terminated. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer.

The Contingency Plan has been in place since 1998 (AFBCA, 1998e; as revised, AFRPA, 2008c; AFCEC, 2013), and in 1997, the Air Force installed and began operating two granular activated carbon (GAC) treatment systems to remove VOCs from three of the off-base drinking water supply wells: OFB-4 (Cal Am Moonbeam Drive Well) and both OFB-51 and OFB-52 (Sacramento County wells at Juvenile Hall). Influent concentrations for the Juvenile Hall wells have remained at concentrations that require treatment or alternate water supply under the Contingency Plan. For the Moonbeam Drive water supply well, in March 2009 a memorandum from AFRPA was submitted to Cal Am that stated the Air Force's intent to terminate the maintenance of the Moonbeam Drive well system 6 months from the date of the memorandum, in accordance with the Contingency Plan, because the well had more than 6 consecutive monthly samples with concentrations of COCs less than one-half maximum contaminant levels (MCLs) (AFRPA, 2009c). GAC treatment ceased from mid-2010 until mid-2012. However, GAC treatment resumed in November 2012 because the carbon tetrachloride (CCl_4) concentration at the Moonbeam Drive well had increased to greater than one-half the MCL (average concentration of six consecutive samples collected between June and August 2012).

Monthly sample collection and analysis at the Moonbeam and Juvenile Hall treatment systems continued through the period of this five-year review to monitor concentrations of COCs in the system influent and midfluent. When breakthrough is detected in the midfluent, effluent samples are collected monthly until carbon changeout occurs. Carbon changeouts of the GAC vessels were performed as necessary and in accordance with the Contingency Plan. Monitoring of these wells and other off-base water supply wells, including other Cal Am wells and privately owned wells, is conducted in accordance with the Contingency Plan.

4.1.3 OU 2 (Groundwater OU) – Site 7 Plume

Remedy Selection. The RAOs identified in the Soil OU and Groundwater OU ROD for the Site 7 Plume are to achieve the ACLs throughout the contaminated aquifer, and to comply with the discharge standards for disposing of the treated water. The remedial action also calls for land-use restrictions on Air Force property, as appropriate, and groundwater monitoring.

The remedial action selected in the Soil OU and Groundwater OU ROD for the Site 7 Plume uses pump-and-treat technology, with removal of volatile contaminants by air stripping, and injection of the treated water into the aquifer. The major components of this remedy include:

- Groundwater extraction at a rate of approximately 250 gpm
- Treatment of the extracted groundwater through air stripping with off-gas treatment (i.e., carbon adsorption) to achieve ACLs (see Table 3-1) and to achieve discharge standards (for treated water and offgas)
- Groundwater injection in compliance with discharge standards (see Table 6-7, AFBCA, 1996a), in combination with other discharge options (to be evaluated during remedial design) that are (a) consistent with attainment of cleanup standards, and (b) cost-effective
- Land-use restrictions implemented on Air Force property as appropriate, to preclude installation of groundwater wells that would not be compatible with protection of public health and the environment
- Groundwater monitoring

An ESD, finalized in 2010, clarifies the next-to-last bullet item above with respect to the implementation of land-use restrictions on Air Force property as part of the Site 7 Plume remedy and establishes additional ICs (AFRPA, 2010a). The RAOs and components of the ICs for the Site 7 Plume are the same as those described in Section 4.1.2 for the Main Base/SAC Area Plume and are not repeated here.

Remedy Implementation. The Site 7 Plume remedial system is installed and operated intermittently between 1998 and 2006 because of gravel mining activities. Groundwater was extracted initially from only one well during the initial phase of the operation. However, this well (FFS-EW7-1) was destroyed in July 1999 due to gravel mining operations in the area.

One extraction well (7-EW-1) was installed near the leading edge of the Site 7 Plume during 4Q00. Startup of the extraction well and restart and proveout of the treatment system began in early April 2001. However, gravel mining activities in the vicinity of 7-EW-1 resumed in July 2001 and, consequently, the conveyance piping was removed and the system was taken offline to accommodate the mining.

An additional extraction well (7-EW-2) was installed during 1Q02, and the treatment system was restarted in March 2002 with only 7-EW-2 operating. The treatment system was taken offline in April 2003 to accommodate aqueduct construction for rerouting of Morrison Creek and other mining and reclamation activities.

The Site 7 groundwater extraction and treatment system resumed operation with both extraction wells (7-EW-1 and 7-EW-2) in December 2006. The use of two extraction wells, rather than the three included in the original remedial design, was the result of both additional groundwater monitoring and model simulations. During 2013, the average flow rate was approximately 42 gpm. Figure 4-3 shows the layout of the groundwater extraction and treatment system for the Site 7 Plume, including two extraction wells, four injection wells, and conveyance piping.

In accordance with the Soil OU and Groundwater OU ROD, land-use restrictions prohibiting, or requiring approval for, any groundwater well construction on Air Force property have been implemented through direct Air Force control prior to property transfer through conditions of leases and through deed restrictions where property has been deeded for all Mather property overlying Groundwater OU contamination. No land-use restrictions have been applied under CERCLA where the Groundwater OU plumes underlie off-base property. However, in 2002, Sacramento County adopted a revised ordinance (County Code Chapter 6.28) that governs drilling of wells within 2,000 feet of any known groundwater contamination. Any permit application to drill or modify a well within this zone requires CVWB consultation prior to the issuing of any well permits. This revised ordinance allows recommendations to the county regarding their permitting choices: to approve, approve with conditions, or deny approval for each permit application. An ESD, finalized in 2010, clarifies the Groundwater OU land-use restrictions with respect to their implementation and adds ICs to protect the remedial system components and to preclude any activities that are inconsistent with the remedial actions or access to the remedial system components (AFRPA, 2010a).

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. Figure 4-3 shows the area of the Site 7 Plume requiring ICs.

In November 2012, the primary parcel associated with the Site 7 Plume (Parcel A-1) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer.

4.1.4 OU 2 (Groundwater OU) – Northeast Plume

Remedy Selection. The RAO identified in the Soil OU and Groundwater OU ROD for the Northeast Plume is to protect the public from inadvertent significant exposure to contaminated groundwater. The Soil OU and Groundwater OU ROD determined that active remediation of the Northeast Plume was not warranted because action was being taken to remediate the source (Landfill Site LF-04) and because removing the low-concentration contaminants from the groundwater would provide little benefit while incurring high costs. The remedial action selected contains the following components:

- ICs (such as deed restrictions) are required to prohibit the installation of groundwater supply wells on Mather the water from which may jeopardize public health or the environment because of COCs in the Northeast Plume. If off-base groundwater wells are proposed or constructed that could result in exposure to contaminated groundwater from the Northeast Plume, the need for active cleanup or other action must be revisited. Contaminant concentration levels in the groundwater will be re-evaluated annually. If the contaminant concentrations decrease to less than the ACLs (see Table 3-1) for 1 year, ICs may be removed.

- Long-term groundwater monitoring will be continued and modified as necessary to monitor contaminant concentrations. Monitoring will be conducted pursuant to Title 23, California Code of Regulations (CCR), § 2550.10 (Corrective Action Monitoring), for at least 1 year from the date that the ACLs are attained. After that time, monitoring will, as required by the Landfill OU ROD, be conducted pursuant to 23 CCR 2550.8 (Detection Monitoring), to detect potential future releases from Landfill Site LF-04.

- Prior to the first CERCLA five-year review, additional predictive modeling will be conducted to assess whether the contaminants will meet the ACLs within a reasonable time. The results of that modeling will be published in an appropriate document or an ESD, if necessary. If, at any time monitoring or modeling indicates that the contaminants will not meet the ACLs within a reasonable time, or at least 40 years from the date of the ROD, or that significant migration of the contaminants may occur at concentrations greater than the ACLs which impacts public health or the environment, active remediation will be reconsidered.

An ESD, finalized in 2010, clarifies the ICs to be applied to Air Force property as part of the Northeast Plume remedy to protect human health and the environment and establishes ICs to protect the monitoring wells used to monitor the performance of the remedy (AFRPA, 2010a). The RAOs and components of the ICs for the Northeast Plume are the same as those described in Section 4.1.2 for the Main Base/SAC Area Plume and are not repeated here.

Remedy Implementation. In accordance with the Soil OU and Groundwater OU ROD, land-use restrictions prohibiting or requiring approval for any groundwater well construction on Air Force property have been implemented through direct Air Force control prior to property transfer through conditions of leases and through deed restrictions where property has been deeded for all property overlying the Northeast Plume contamination. No land-use restrictions have been applied under CERCLA where the Groundwater OU plumes underlie off-base property. However, in 2002, Sacramento County adopted a revised ordinance (County Code Chapter 6.28) that governs drilling of wells within 2,000 feet of any known groundwater contamination. Any permit application to drill or modify a well within this zone requires CVWB consultation prior to the issuing of any well permits. This revised ordinance allows recommendations to the county regarding their permitting choices: to approve, approve with conditions, or deny approval for each permit application. An ESD, finalized in 2010, clarifies the Groundwater OU land-use restrictions with respect to their implementation and adds ICs to protect the remedial system components and to preclude any activities that are inconsistent with the remedial actions or access to the remedial system components (AFRPA, 2010a).

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. With regulatory agency notification and approval, one groundwater monitoring well was installed in October 2012. Figure 4-4 shows the area of the Northeast Plume requiring ICs.

In November 2012, the parcel associated with the Northeast Plume (Parcel A-3) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. In June 2013, a SLUC was executed for this parcel; therefore, the new property owner is required to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer.

The ARARs cited in the Soil OU and Groundwater OU ROD and governing groundwater monitoring include portions of CCR Title 23, Division 3, Chapter 15, Article 5, which describe groundwater monitoring programs for discharges of hazardous wastes to land. (Landfill Sites LF-03 and LF-04 are known or suspected sources for VOC groundwater contamination for the Northeast Plume.) The applicable monitoring programs include detection and corrective action monitoring programs. Accordingly, the Northeast Plume performance monitoring program that has been in place since the Soil OU and Groundwater OU ROD was signed in 1996 fulfills the corrective action monitoring ARAR. In addition, monitoring for new releases of VOCs from landfill Sites LF-03 and LF-04 is conducted under the detection monitoring ARAR. Figure 4-4 shows wells used for monitoring the Northeast Plume.

The ROD commitment to perform modeling prior to the first five-year review, to predict how much time will be required for the contaminant concentrations to decrease to less than the ACLs, was not accomplished for that review. An evaluation of the Northeast Plume was conducted between 2001 and 2002, and a review of concentration data over time revealed that concentrations of COCs exhibited sporadic patterns that did not allow for confident predictions of future concentrations (AFBCA, 2002). That evaluation recommended continued monitoring of the Northeast Plume, as opposed to initiating active remediation, and recommended a similar evaluation be conducted periodically as monitoring data warrant, but no less frequently than the five-year reviews.

The *Second Five-Year Review Report* stated that future predictive modeling was potentially viable based on the evident start of decreasing contaminant concentration trends observed within that time period (AFRPA, 2005). The report recommended that the annual groundwater monitoring reports provide projections and an assessment of trends in the wells with the highest concentrations that may indicate when ACLs might be achieved or an assessment that the data indicates a pattern insufficient for a projection (AFRPA, 2005). Concentration changes and trends in groundwater in the Northeast Plume monitoring wells are evaluated in each annual groundwater monitoring report. However, predictive modeling was not conducted in the annual groundwater monitoring reports due to increasing concentration trends at wells with concentrations greater than ACLs between approximately 2004 and 2006/2007.

As documented in the *Third Five-Year Review Report* (URS, 2010) and the memorandum *Predictive Trend Analysis for the Northeast Plume Contaminants of Concern* (AFRPA, 2010d), decreasing COC concentration trends allowed a projection of when (approximately 2025 based on extrapolation of a best-fit exponential trend line) ACLs may be achieved in the Northeast Plume (URS, 2010). While COC concentrations (specifically, PCE and cis-1,2-DCE) at most Northeast Plume wells have continued to decrease since 2009, they have been increasing at two wells at concentrations greater than ACLs; therefore, an updated prediction of when ACLs may be achieved cannot be made at this time.

4.1.5 Groundwater Monitoring Program

The Groundwater Monitoring Program at Mather provides periodic groundwater data from monitoring wells, extraction wells, injection wells, piezometers, and potable water wells located on the former base and properties beyond the boundaries of the former base. Approximately 570 groundwater monitoring wells and piezometers, 35 active extraction wells, and 49 private wells were included in the monitoring program at Mather during 2013.

The groundwater monitoring program objectives include:

- Monitoring seasonal variations in groundwater elevations and gradients within each HSG unit
- Monitoring the extent of contamination and progress toward achieving ACLs

- Evaluating hydraulic capture by the groundwater extraction wells
- Evaluating the performance of groundwater extraction and treatment systems, including monitoring of mass removal efficiency and compliance with discharge standards
- Assessing the potential impact of contaminant plumes on the off-base drinking water supply wells
- Monitoring groundwater quality in the landfill areas (detection monitoring and evaluation monitoring)
- Monitoring groundwater quality in the zones where treated water is injected
- Monitoring surface water quality where treated groundwater is discharged

Groundwater monitoring data are collected periodically at Mather, and monitoring results are presented quarterly. Depth-to-groundwater measurements were collected at least quarterly from 1990 through 2006; starting in 2007, however, they have been collected semiannually during the second and fourth quarter sampling events. Additional water level measurements are collected as necessary to determine horizontal and vertical gradient patterns in areas where additional data are needed by the monitoring program for evaluation of remedy performance. Data collected each quarter are presented in quarterly fact sheets (first, second, and third quarters only). Interpretation of the data is performed and reported annually in the annual groundwater monitoring reports that are prepared following the fourth quarter monitoring event. The interpretation includes evaluation of groundwater level changes, gradients, flow directions, capture, and groundwater quality.

As the Groundwater Monitoring Program at Mather has matured, the focus of the program has transitioned from investigation and characterization to performance monitoring of the remedial actions. The current emphasis is on monitoring capture at plume boundaries and receptor pathways. Therefore, the sampling frequency decision tree presented on Figure 4-5 has evolved over time since it was first developed in 1992. The *2006 Groundwater Monitoring Program Evaluation Report* (GWMPER) presents a detailed discussion regarding the Groundwater Monitoring Decision Tree (MWH, 2007b) with additional changes described in the *2009 Groundwater Monitoring Program Sampling Plan* (MWH, 2009c), the successor to the GWMPER. In addition, an extraction well shutdown decision logic has been developed, as shown in Figure 4-6. This decision logic provides the criteria used to determine when an extraction well may be taken offline.

4.1.6 Operations and Maintenance

The groundwater remedies are operated in accordance with the O&M manuals for the AC&W OU, Main Base/SAC Area Plume, and the Site 7 Plume, which describe procedures to operate and maintain the three groundwater treatment systems at Mather (EA Engineering, 1995; Montgomery Watson, 1997a; 1999c; MWH, 2003a). In 2010, the O&M manuals were updated for the AC&W OU, Main Base/SAC Area Plume, and the Site 7 Plume (MWH, 2010e; 2010f; 2010g). Modifications to the groundwater treatment systems, such as the installation of new extraction wells for refinement of plume control, are planned and implemented independently of the groundwater treatment system O&M program. Accordingly, the decision-making criteria and guidance for long-term management of the groundwater treatment systems are evaluated in the annual groundwater monitoring reports, not the O&M manuals.

A combination of routine weekly, monthly, quarterly, semiannual, and annual O&M activities are conducted for the extraction and treatment systems. These O&M activities include but are not limited to:

- Recording and monitoring all pertinent operational data

- Inspecting mechanical operation of all equipment at the wellhead of each extraction well, injection well, the Mather Lake discharge pipeline (AC&W only), and the West Ditch discharge outlet

- Maintaining the equipment based on manufacturer specifications

- Redevelopment/rehabilitation of extraction and injection wells

- Performing necessary repairs and system upgrades

- Compiling data into appropriate tables and charts that allow observations to be made about overall system performance

Scheduled and unscheduled treatment system shutdowns are reported in annual groundwater monitoring reports, which are provided to regulatory agencies. Numerous maintenance activities and system improvements have been implemented since the treatment plants have been put into operation.

4.2 OU 3 (Soil OU)

4.2.1 Site WP-07/FT-11

Remedy Selection. The RAOs identified in the Soil OU and Groundwater OU ROD for Site WP-07/FT-11 are to achieve cleanup standards for the COCs, to mitigate any residual source of groundwater contamination that may be present, and to comply with ARARs for the Site WP-07 solid waste disposal site.

The remedial action selected in the Soil OU and Groundwater OU ROD for Site WP-07/FT-11 was modified by an ESD (AFBCA, 1998a). The ESD changes installation of the prescriptive landfill cover with a vegetative cap under certain conditions to an engineered cap to allow use of contaminated soil from other sites to build up the cap foundation (AFBCA, 1998a). The major components of the remedy, with the ESD modifications shown in *italics,* include:

- Filling in the depression at Site WP-07 with inert fill *or soils meeting acceptance criteria in the ESD.*

- Treating contaminated shallow and deep soils at Sites WP-07 and FT-11 by in situ bioremediation and possibly SVE. If significant amounts of solvents are encountered, the in situ bioremediation system could be converted to an SVE system to speed up remediation.

- Installing a prescriptive landfill cover over the Site WP-07 impacted area [*the ESD deletes the following ROD condition:* “if site conditions indicates it is appropriate, or a vegetative cover if there is no threat to groundwater quality nor generation of landfill gases”], using inert soils and/or non-designated soils to construct the foundation for the cap/cover.

- Monitoring groundwater if contamination remains in place that threatens groundwater quality.

The ROD remedy also includes land-use restrictions to protect the landfill cap at Site WP-07. An ESD, finalized in 2010, clarifies the ICs and augments the remedy by establishing additional ICs at Site WP-07 (AFRPA, 2010a). The ESD replaces numeric soil cleanup levels for TPH-d and TPH-g with narrative soil cleanup levels at Site WP-07/FT-11.

The RAOs for the ICs are: (1) protecting the integrity of the soil remedial actions and systems, including the associated monitoring systems, and (2) preserving access for the Air Force, EPA, and the State of California to the site, the remedial systems, and associated monitoring systems.

The specific ICs have been documented as environmental restrictive covenants in the deed for the parcel associated with Site WP-07/FT-11 that has been transferred from Air Force ownership (Parcel A-1). The transferee is prohibited from:

- Damaging/disturbing/tampering with, or allowing others to damage/disturb/tamper with, the remediation system components, including but not limited to the extraction and injection systems, treatment systems, conveyance pipes, electrical, gas, or fiber optic lines, or monitoring wells, until such time as remediation is complete or components are no longer to be used for remediation

- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of any remediation system component

- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to the site or to any equipment or component associated with the soil remediation systems

- Interfering with the remedial action or damaging/disturbing/penetrating the engineered landfill cap or damaging/disturbing/ tampering with/removing or interfering with any associated remedial system components (e.g., containment system, drainage systems, erosion control systems for the landfill cap, survey monuments, gas vents, gas migration monitoring wells, groundwater monitoring system, access roads, settlement monuments, fencing, signage), or allowing others to do so, until such time as remediation is complete or the component is no longer used for the remedial action

- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of the landfill cap or any associated remedial system component

- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to the landfill cap or any associated remedial system component

- Using, or allowing others to use, the property within the landfill cap outline identified in Figure 3 of the ESD for residential purposes (including mobile or modular homes), hospitals for human, public or private schools for persons under 18 years of age, nursery schools, or for day care centers for children

Site WP-07 will also have the following institutional controls:

- Controls to minimize potential for completing the inhalation exposure pathway for methane and other gasses potentially migrating from the landfill sites require future landowners to obtain approval from the State of California for any changes in land use or site improvements within 1,000 feet of a landfill, until and unless it is demonstrated that the landfill is no longer a threat to human health and the environment. This requirement is based on regulations at 27 CCR 21190 that apply to landfill properties.

Remedy Implementation. The depression at Site WP-07 was filled with soil from other IRP sites to create positive drainage away from the disposal site, and a landfill cap was constructed at the site in 1999.

Site WP-07 has been closed in accordance with ARARs for a Class III landfill. Post-closure inspections and maintenance of the cap, drainage system, and other landfill structures; monitoring of landfill gas generation and migration, and monitoring of groundwater quality are conducted in accordance with the *Closure and Post-Closure Maintenance Plan for the Engineered Cap at Remedial Action Site 7* (Montgomery Watson, 1999d; as revised, MWH, 2010h). Results of these activities are reported in quarterly field logs and annual post-closure landfill inspection and gas monitoring reports. Groundwater monitoring at Site WP-07/FT-11 is conducted by the Groundwater Monitoring Program, as described in Section 4.1.5. The results of groundwater monitoring are reported in the quarterly fact sheets and annual groundwater monitoring reports. Topographic surveys are conducted approximately every 5 years to monitor differential settlement of Site WP-07; the most recent survey was completed in 2013 (URS, 2013c).

Through 2Q13, landfill gas monitoring (field measurements) was conducted quarterly at Site WP-07. Based on a history of low and compliant methane and VOC field measurements, the frequency of landfill gas monitoring at Site WP-07 has been reduced from quarterly to annually, as recommended in the *2012 Annual Post-Closure Landfill Inspection and Gas Monitoring Report* (URS, 2013d). Beginning in 2014, landfill gas monitoring at Site WP-07 will be conducted only during the first quarter. Quarterly post-closure inspections were conducted throughout the period of this five-year review. Figure 4-7 shows the Site WP-07 passive landfill cap gas vents and perimeter gas migration probes.

VOCs in the vadose zone at Site WP-07 and Site FT-11 were initially remediated by separate SVE systems starting in late 1998, but the extraction systems were later combined and operated with a single treatment unit. In April 2007, the SVE treatment system was shut down, and a BV system was started, as volatile contaminant concentrations had significantly decreased. The BV system was permanently shut down in May 2009, and in 2011, a closure report was finalized documenting that no further treatment of the vadose zone is necessary at Site WP-07/FT-11 (URS, 2011a). In 2012, the SVE/BV system and components were decommissioned (URS, 2012a), except for a few BV wells retained for use by the Groundwater Monitoring Program. Figure 4-7 shows the layout of the former SVE/BV system at Site WP-07/FT-11, including BV air injection wells, horizontal BV wells, and soil vapor monitoring wells. Appendix A provides the operational and remedial history for the Site WP-07/FT-11 remedial system.

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2013, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. The perimeter security fences have remained intact and signs visible and in good condition. The Site WP-07/FT-11 SVE/BV system and components have been decommissioned; therefore, the ICs related to protection of those components no longer apply, except for the few BV wells that were not decommissioned. Figure 4-7 shows the area of Site WP-07/FT-11, including the 1,000 foot buffer, requiring ICs.

In November 2012, one of two parcels associated with Site WP-07 was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel (A-1) that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. The other parcel (A-2) was assigned to, and accepted by, the DOI in January 2013 but, as of October 2014, had not yet been transferred to Sacramento County. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer.

4.2.2 Site ST-37/ST-39/SS-54

Remedy Selection. The RAOs identified in the Soil OU and Groundwater OU ROD for Site ST-37/ST 39/SS-54 are to achieve cleanup standards for the COCs and to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Soil OU and Groundwater OU ROD for Site ST-37/ST-39/SS-54 includes these major components:

- Excavating approximately 220 cubic yards (cy) of contaminated surface soils to remove all contamination above acceptable levels
- Transporting excavated soils to the on-base ex situ bioremediation facility
- Treating excavated soils by ex situ bioremediation as appropriate
- Transporting treated soils to, and consolidating them with, landfill cap foundation materials at Site WP-07, as appropriate
- Treating contaminated shallow and deep soils by in situ bioremediation and possible SVE. The in situ bioremediation system could be converted if appropriate, to an SVE system if significant amounts of solvents are encountered to speed up remediation
- Monitoring groundwater if contamination that threatens groundwater quality remains at the site

An ESD, finalized in 2010, adds ICs to the remedy at Site ST-37/ST-39/SS-54 (AFRPA, 2010a). The ESD replaces numeric soil cleanup levels for BTEX, TPH-d, and TPH-g with narrative soil cleanup levels at Site ST-37/ST-39/SS-54.

The RAOs for the ICs are: (1) preventing unacceptable human exposure to soil vapor or residual contamination; (2) protecting the integrity of the soil remedial actions and systems, including the associated monitoring systems; and (3) preserving access for the Air Force, EPA, and the State of California to the site, the remedial systems, and associated monitoring systems.

The specific ICs have been documented as environmental restrictive covenants in the deed for the parcel associated with Site ST-37/ST-39/SS-54 (Parcel A-1) (including the extension to Site ST-29/ST-71, a non-CERCLA site, and monitoring wells at Sites OT-23B and OT-23D from the Basewide OU) that has been transferred from Air Force ownership. The transferee is prohibited from:

- Damaging/disturbing/tampering with, or allowing others to damage/disturb/tamper with, the remediation system components, including but not limited to the extraction and injection systems, treatment systems, conveyance pipes, electrical, gas, or fiber optic lines, or monitoring wells, until such time as remediation is complete or components are no longer to be used for remediation
- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of any remediation system component

- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to the site or to any equipment or component associated with the soil remediation systems

In addition to the ICs identified above, the following ICs will be imposed, if necessary, to prevent health risks from exposure to VOC-contaminated shallow soils. The transferee is prohibited from:

- Engaging in any surface or shallow soil disturbance (in the geographic area subject to the IC), until and unless it is demonstrated that VOC contamination at these site(s) is no longer a threat to human health and the environment

- Constructing any structures for human occupation (in the geographic area subject to the IC) without evaluating or addressing the risks posed by vapor intrusion

If the site soil vapor data demonstrate that all soil vapor concentrations for each COC are compatible with unrestricted land use, these ICs will no longer be required by the remedy.

Remedy Implementation. The Soil OU and Groundwater OU ROD stated that approximately 220 cy of surface soils were to be excavated and treated at the on-base ex situ bioremediation facility. Following treatment, the soil was to be consolidated with landfill cap foundation materials at Site WP-07. However, prior to excavation, trenching activities were conducted to determine the extent of soil requiring removal to meet the site's cleanup levels. Based on the trenching results, the portion of the site identified by the Soil OU and Groundwater OU ROD as requiring excavation met the cleanup levels without further excavation (Montgomery Watson, 2000a). Therefore, no excavation was conducted with the exception of the soils from the investigative trenches.

An SVE system (vapor extraction with vapor treatment by a thermal oxidizer with a capacity of 1,000 standard cubic feet per minute [scfm]) was constructed in summer 1998 and, after a period of start-up and troubleshooting, became fully operational in December 1998. This system operated until January 2006 when it was taken offline because of a faulty heat exchanger. A replacement treatment system (500 scfm thermal oxidizer) became operational in February 2007. SVE operated until January 2010, and in October 2010, the SVE system was converted to a BV system. The BV system was shut down in December 2013 for respiration testing, and in 2014, the Air Force is scheduled to assess the site for closure of the vadose zone. (Contamination in this area found during investigation of the sewer line [Subsites 23B and 23D] is to be addressed by the Sites 37/39/54 remedy and addressed in the closure process.)

Figure 4-8 shows the layout of the Site ST-37/ST-39/SS-54 system, including SVE/BV wells and soil vapor monitoring probes/wells used to monitor vapor concentrations and remedial progress at the site. Appendix A provides the operational and remedial history for the Site ST-37/ST-39/SS-54 remedial system.

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)

- In 2012, covering all of 2012 (URS, 2013b)

- In 2013, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. With regulatory agency notification and approval, a trench was dug to plumb an existing vapor well to the remediation system and was backfilled in March 2012. Figure 4-8 shows the area of Site ST-37/ ST-39/SS-54 requiring ICs.

In November 2012, the parcel associated with Site ST-37/ST-39/SS-54 (Parcel A-1) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on the ICs before and after property transfer.

4.2.3 Site SD-57

Remedy Selection. The RAOs identified in the Soil OU and Groundwater OU ROD for Site SD-57 are to achieve cleanup standards for the COCs and to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Soil OU and Groundwater OU ROD for Site SD-57 includes the following major components:

- Treating contaminated shallow and deep soils by in situ SVE
- Monitoring groundwater if contamination that threatens groundwater quality remains at the site

An ESD, finalized in 2010, adds ICs to the remedy at Site SD-57 (AFRPA, 2010a). The RAOs and components of the ICs for Site SD-57 are the same as those described in Section 4.2.2 for Site ST-37/ ST-39/SS-54 and are not repeated here.

Remedy Implementation. In August 1997, an SVE system began operating at Site SD-57, and SVE operated in various treatment modes (i.e., catalytic mode and GAC) until 2013. In 2001, DPE was initiated in three water table groundwater extraction wells that not only removed vapor but also increased the groundwater extraction rate for the wells. The current SVE system is a 650-scfm vacuum extraction system. With SMAQMD concurrence, the Site SD-57 SVE system has operated with, when necessary, or without air emission treatment (GAC). The SVE system was shut down for rebound testing at the end of July 2013, and vadose zone modeling results indicated that residual TCE in soil vapor would not significantly impact groundwater or extend groundwater remediation time.

In April 2014, a draft closure report was submitted for regulatory agency review; the report documented that no further treatment of the vadose zone was necessary at Site SD-57. However, the results from additional confirmation soil vapor samples collected from the vapor wells in August 2014 prompted the postponement of the closure report and resumption of SVE operations in September 2014.

Figure 4-9 shows the layout of the Site SD-57 system, including SVE wells, DPE wells, and soil vapor monitoring probes/wells to monitor vapor concentrations and remedial progress at the site. Appendix A provides the operational and remedial history for the Site SD-57 remedial system).

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. A building was demolished in 2011 that caused minimal surface disturbance, but no ICs were violated. Figure 4-9 shows the area of Site SD-57 requiring ICs.

In November 2012, the parcel associated with Site SD-57 (Parcel A-1) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on the ICs before and after property transfer.

4.2.4 Site SD-59

Remedy Selection. The RAOs identified in the Soil OU and Groundwater OU ROD for Site SD-59 are to achieve cleanup standards for the COCs and to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Soil OU and Groundwater OU ROD for Site SD-59 includes the following major components:

- Excavating approximately 1,200 cy of contaminated shallow soils to remove all contamination above acceptable levels
- Transporting excavated soils to the on-base ex situ bioremediation facility
- Treating excavated soils by ex situ bioremediation as appropriate
- Transporting treated soils to, and consolidating them with, landfill cap foundation materials at Site LF-04 or Site WP-07, as appropriate
- Monitoring groundwater if contamination that threatens groundwater quality remains at the site

As discussed below under remedy implementation, contaminated soil remained following the excavation at Site SD-59 that would have been prohibitively costly to remove and would have required demolition of nearby structures. Therefore, an ESD was prepared to add in situ treatment (SVE/BV) to the remedy (AFBCA, 1998b). The following components were added to the Site SD-59 remedy:

- Installation of injection/extraction wells and monitoring points
- Removal of contaminated surface soil with off-site disposal as appropriate
- Pilot test to optimize the efficiency and cost of the SVE and/or the BV system

- Startup, operation, and maintenance of the system (including a potential switch from SVE to BV)
- Closure of the site after remedial goals have been met

A second ESD, finalized in 2010, adds ICs to the remedy at Site SD-59 (AFRPA, 2010a). This ESD replaces numeric soil cleanup levels for TPH-d and TPH-g with narrative soil cleanup levels at Site SD-59. The RAOs and components of the ICs for Site SD-59 are the same as those described in Section 4.2.2 for Site ST-37/ST-39/SS-54 and are not repeated here. Note that the ICs for protection of remedy components also apply to the SVE components at Site LF-18 (Basewide OU), which was remediated with Site SD-59. However, the ICs to protect those components no longer apply because SVE operations at Site LF-18 ceased in 2008, and the SVE components were decommissioned in 2012.

Remedy Implementation. In August and September 1996, approximately 750 cy of contaminated soil were excavated in an attempt to reach the cleanup levels for TPH-g and TPH-d. However, petroleum hydrocarbons were detected in samples collected between 10 to 22 feet bgs in the sidewalls and from soil borings at concentrations greater than the cleanup levels for both TPH-g and TPH-d (Montgomery Watson, 1997b). Thus, remediation to the cleanup levels through excavation was no longer considered feasible because costs to continue excavating were prohibitive and because surrounding structures would have needed demolition to allow access for excavation.

After the soil excavation, regulatory review of Site SD-59 raised issues regarding the presence of chlorinated VOCs in the soil samples collected at the sidewalls of the excavation, and the concern that these VOCs potentially could migrate to groundwater. Soil cleanup levels were not specified for chlorinated VOCs in the Soil OU and Groundwater OU ROD (AFBCA, 1996a). The ROD requirements were modified by an ESD, which required characterization and evaluation for the presence of chlorinated VOCs in shallow soils and installation of an SVE system at Site SD-59 (AFBCA, 1998b). If chlorinated VOCs were detected at concentrations that posed a threat to groundwater quality, additional SVE wells would be considered for installation to extract the VOCs from the vadose zone.

Two phases of post-ROD characterization were conducted at Site SD-59, which included installation of multi-probe soil vapor monitoring points (SVMPs) and SVE wells and a pilot test of the SVE system beginning in December 1998. Full-scale operations began in 2000. Starting in August 2001, the 750-scfm SVE GAC system located at Site SD-59 was used to remediate vapors at Site SD-59 and/or Site LF-18 (Basewide OU). With SMAQMD concurrence, the Site SD-59 SVE system has operated with, when necessary, or without air emission treatment (GAC).

At the end of July 2013, the SVE system was shut down for further evaluation, and a closure report was scheduled for preparation in 2014. Data from additional vapor wells installed in 2014 suggest that the original Site SD-59 VOC source has been remediated but another source area may exist near Building 4260 (see Figure 4-10) that is outside of the current IC boundary. Additional investigation and assessment activities are recommended in this area. It is also recommended that the IC boundary be extended to the south and east to include this area.

Figure 4-10 shows the layout of the Site SD-59 system, including SVE wells and soil vapor monitoring probes/wells to monitor vapor concentrations and remedial progress at the site. Appendix A provides the operational and remedial history for the Site SD-59 remedial system.

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)

- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. With regulatory agency notification and approval, excavation, and horizontal drilling were conducted to connect three existing soil vapor monitoring wells to the remediation system for SVE operations. Figure 4-10 shows the area of Site SD-59 requiring ICs.

In November 2012, the parcel associated with Site SD-59 (Parcel A-1) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on the ICs before and after property transfer.

4.2.5 Operations and Maintenance

During the period of this five-year review, the SVE/BV treatment systems for the Soil OU sites described in Sections 4.2.1 through 4.2.4 were operated in accordance with the *Soil Vapor Extraction and Bioventing Remedial Treatment Systems Operations and Maintenance Manual for Sites 7/11, 10C/68, 23C, 29/71, 37/39/54, 57, and 18/59* (MWH, 2009d). A combination of routine weekly, monthly, quarterly, semiannual, and annual O&M activities are conducted for the SVE/BV treatment systems. Specific O&M tasks are outlined in the O&M manual.

In addition, the landfill cap at Site WP-07 described in Section 4.2.1 is being maintained and monitored in accordance with the *Closure and Post-Closure Maintenance Plan for the Engineered Cap at Remedial Action Site 7* (Montgomery Watson, 1999d; as revised, MWH, 2010h) and the *Addendum to the Final Basewide Groundwater Monitoring Sampling and Analysis Plan for Landfill Gas Monitoring – Revision 1* (Montgomery Watson, 2000c).

4.3 OU 4 (Landfill OU)

4.3.1 Site LF-03

Remedy Selection. The RAOs identified in the Landfill OU ROD for Site LF-03 are to close the landfill in compliance with ARARs and, thereby, protect human health and the environment.

The remedy selected in the Landfill OU ROD for Site LF-03 is an engineered cap (AFBCA, 1995a). The major components of the remedy include:

- Installing an engineered cap
- Installing passive gas vent wells
- Monitoring of groundwater and landfill gas for at least 5 years
- Invoking access restrictions (i.e., fencing and deed restrictions)

A memorandum of post-ROD changes, finalized in 2009, clarifies and supplements the ICs at Site LF-03 (AFRPA, 2009a). The RAOs for the ICs are: (1) preventing human exposure to methane in structures that may be built within 1,000 feet of the site; (2) protecting the integrity of the remedial system(s), including the associated monitoring system; and (3) protecting necessary access to the site and to the remedial system(s), including the associated monitoring system.

The specific ICs have been documented as environmental restrictive covenants in the deeds for parcels A-1 and A-3 and restrictions/prohibitions in the SLUC for parcel A-3 associated with LF-03 that have been transferred from Air Force ownership. The ICs include:

- Controls to minimize potential for completing the inhalation exposure pathway for methane and other gasses potentially migrating from the landfill sites, require future landowners to obtain approval for any changes in land use or site improvements within 1,000 feet of a landfill from the state, until and unless it is demonstrated that the landfill is no longer a threat to human health and the environment. This requirement is based on regulations at 27 CCR 21190 that apply to landfill properties.

- Controls to prohibit the destruction or disturbance of, or interference with, the remedial action, including the landfill caps and associated remediation system components, drainage systems, erosion control systems for the landfill cap, survey monuments, gas vents, gas migration monitoring wells, groundwater monitoring wells, fencing, signage, and access roads, until such time as remediation is complete or components are no longer to be used for remediation.

- Controls to prohibit any activities that would limit access to the site or to any equipment or systems associated with the remedial action, including the landfill caps and drainage structures and systems, gas monitoring wells, groundwater monitoring wells, gas venting equipment, survey monuments, fences and signage, and any other component of the remedial action.

Remedy Implementation. Site LF-03 was capped and closed successfully in 1996. The site is fenced and protected from disturbance by conditions in the deed to Sacramento County. Post-closure inspections and maintenance of the cap, drainage system, and other landfill structures; monitoring of landfill gas generation and migration, and monitoring of groundwater quality are conducted in accordance with the *Closure and Post-Closure Maintenance Plan for the Landfill Operable Unit* (Montgomery Watson, 1996; as revised MWH, 2010i). The results of these activities are reported in the quarterly field logs and annual post-closure landfill inspection and gas monitoring reports. Groundwater monitoring at Site LF-03 is conducted by the Groundwater Monitoring Program, as described in Section 4.1.5. The results of groundwater monitoring for Site LF-03 are reported in the quarterly fact sheets and annual groundwater monitoring reports. Topographic surveys are also conducted approximately every 5 years to monitor differential settlement of Site LF-03; the most recent survey was completed in 2013 (URS, 2013c).

Through 2Q13, landfill gas monitoring (field measurements) was conducted quarterly at Site LF-03. Based on a history of low and compliant methane and VOC field measurements, the frequency of landfill gas monitoring at LF-03 has been reduced from quarterly to annually, as recommended in the *2012 Annual Post-Closure Landfill Inspection and Gas Monitoring Report* (URS, 2013d). Beginning in 2014, landfill gas monitoring will be conducted only during the first quarter at Site LF-03. Quarterly post-closure inspections were conducted throughout the period of this five-year review. Figure 4-11 shows the Site LF-03 passive landfill gas vents and perimeter landfill gas migration probes.

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2010, covering the period August 2009 through August 2010 (AFRPA, 2010c)

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. In 2010, Sacramento County decommissioned two shallow soil vapor monitoring wells installed in conjunction with a proposed sewer pipeline. In 2011, with the approval of the Air Force and regulatory agencies, including CalRecycle, an extension of Zinfandel Drive was constructed, which passes through the IC area. The roadbed was determined not to provide a significant conduit for landfill gases. The perimeter security fences have remained intact and signs visible and in good condition, although repairs to the secondary fence (non-ARAR related) were made in 2010, 2011, and 2012 to discourage trespassing. Figure 4-11 shows the area of Site LF-03, including the 1,000 foot buffer, requiring ICs.

In November 2012, the two parcels associated with Site LF-03 (parcels A-1 and A-3) were transferred from Air Force ownership, and the deed restriction language in the Memorandum of Post-ROD Changes (AFRPA, 2009a) was included in the deeds. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deeds. As of October 2014, a SLUC is in place for the parcel (A-3) containing Site LF-03 and another SLUC is in preparation for the parcel (A-1) containing part of the 1,000-foot buffer around Site LF-03. The SLUC requires or will require the new property owner to conduct annual IC inspections and to report on those inspections to the state until the ICs at the site are terminated. As of October 2014, the state had not received a compliance report from the new landowner, Sacramento County. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer.

4.3.2 Site LF-04

Remedy Selection. The RAOs identified in the Landfill OU ROD for Site LF-04 are to close the landfill in compliance with ARARs and to, thereby, protect human health and the environment.

The remedy selected in the Landfill OU ROD for Site LF-04 is an engineered cap (AFBCA, 1995a). The major components of the remedy include:

- Installing an engineered cap
- Installing flood control measures (e.g., embankment)
- Installing passive gas vent wells
- Monitoring of groundwater and landfill gas for at least 5 years
- Invoking access restrictions (i.e., fencing and deed restrictions)

The Landfill OU ROD also includes consolidation at Site LF-04 of wastes excavated from Sites LF-05 and LF-06. Additional material from Site FT-10C and Site LF-02 was consolidated into LF-04 as authorized in removal action memoranda in 1996 (AFBCA, 1996c; 1996d). In addition, the *Explanation of Significant Difference from the Record of Decision, Consolidation of Additional Refuse & Debris into Landfill Site 4* (AFBCA, 1996b) was prepared to modify the remedy at Site LF-02 to include consolidation of waste at Site LF-04 and also included use of soil from Site OT-69 for foundation material at Site LF-04.

A memorandum of post-ROD changes, finalized in 2009, clarifies and supplements the ICs at Site LF-04 (AFRPA, 2009a). The RAOs and components of the ICs for Site LF-04 are the same as those described in Section 4.3.1 for Site LF-03 and are not repeated here.

Remedy Implementation. In 1996, Site LF-04 was capped, and in 1997 the placement of vegetation on the cap was completed. The site is fenced and protected from disturbance by conditions in the deed to Sacramento County. Post-closure inspections and maintenance of the cap, drainage system, and other landfill structures; monitoring of landfill gas generation and migration; and monitoring of groundwater quality are conducted in accordance with the *Closure and Post-Closure Maintenance Plan for the Landfill Operable Unit* (Montgomery Watson, 1996; as revised MWH, 2010i). The results of these activities are reported in the quarterly field logs and annual post-closure landfill inspection and gas monitoring reports. Groundwater monitoring at Site LF-04 is conducted by the Groundwater Monitoring Program, as described in Section 4.1.5. The results of groundwater monitoring for Site LF-04 are reported in the quarterly fact sheets and annual groundwater monitoring reports. Topographic surveys are also conducted approximately every 5 years to monitor differential settlement of Site LF-04; the most recent survey was completed in 2013 (URS, 2013c).

Because historic concentrations of methane measured at the north property boundary were greater than the action level of 5 percent methane by volume in air, suggesting the potential for off-base methane gas migration, a passive gas migration control system was constructed in June 1998 along the north perimeter of Site LF-04. Further, a contingency plan was prepared to address additional measures to be taken should gas concentrations fail to meet standards in a reasonable amount of time (Montgomery Watson, 1999e).

Throughout the period of this five-year review, quarterly landfill gas monitoring (field measurements and when necessary, samples for laboratory analysis) and post-closure inspections were conducted. Unlike Sites WP-07 and LF-03, occasional exceedances of the 5 percent compliance concentration for methane have discouraged reduction of the landfill gas monitoring frequency at Site LF-04, which is planned to remain quarterly in 2014. Figure 4-12 shows the Site LF-04 passive landfill gas migration control trench system vents, passive landfill gas vents, and perimeter gas migration probes.

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2010, covering the period August 2009 through August 2010 (AFRPA, 2010c)
- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. In 2011, with the approval of the Air Force and regulatory agencies, including CalRecycle, an extension of Zinfandel Drive was constructed, which passes through the IC area. The roadbed was determined to not provide a significant conduit for landfill gases. With regulatory agency notification and approval, one groundwater monitoring well was installed to the west of Site LF-04 in October 2012. The perimeter security fences have remained intact, although repairs to the secondary fence (non-ARAR related) were made in 2011 and 2012 to discourage trespassing and one gate hinge on the primary security fence was repaired in 2010. In addition, in 2010 and 2014, chains were added to secure two personnel gates in the security fence after the latches were no longer working effectively. Signs are visible and in good condition. Figure 4-12 shows the area of Site LF-04, including the 1,000 foot buffer, requiring ICs.

In November 2012, the parcel associated with Site LF-04 (Parcel A-3) was transferred from Air Force ownership, and the deed restriction language in the Memorandum of Post-ROD Changes (AFRPA, 2009a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. In June 2013, a SLUC was executed for this parcel; therefore, the new property owner is required to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. As of October 2014, the state had not received a compliance report from the new landowner, Sacramento County. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer.

4.3.3 Operations and Maintenance

During the period of this five-year review, the landfill caps at Sites LF-03 and LF-04 described in Sections 4.3.1 and 4.3.2 were maintained and monitored in accordance with their post-closure O&M manuals, including:

- *Closure and Post-Closure Maintenance Plan for the Landfill Operable Unit* (Montgomery Watson, 1996; as revised MWH, 2010i)

- *Landfill LF04 Methane Gas Migration Contingency Plan, Mather Air Force Base, California* (Montgomery Watson, 1999e)

- *Addendum to the Final Basewide Groundwater Monitoring Sampling and Analysis Plan for Landfill Gas Monitoring – Revision 1* (Montgomery Watson, 2000c)

Quarterly landfill inspections and gas monitoring includes:

- Inspection of the final caps, drainage systems, and other landfill structures, including access roads, fencing and signs, and condition of gas vents, gas migration probes, and groundwater monitoring wells

- Monitoring of landfill gas vents (on the landfill cap) and gas migration probes (outside the cap perimeter with a combustible gas indicator and infrared gas analyzer calibrated for methane and used to monitor methane at the perimeter landfill gas migration probes

- Monitoring the passive gas migration control trench system at the northern boundary of Site LF-04

- Monitoring of groundwater quality

Every 5 years, a topographic survey is conducted to monitor differential settlement of the landfills. Numerous maintenance activities and gas monitoring and drainage system improvements have been implemented since the final caps were constructed at Sites LF-03 and LF-04.

4.4 OU 5 (Basewide OU)

4.4.1 Site FT-10C/ST-68

Remedy Selection. The RAOs identified in the Basewide OU ROD for Site FT-10C/ST-68 are to achieve cleanup standards for the COCs, and to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Basewide OU ROD for Site FT-10C/ST-68 includes the following major components:

- In situ treatment of the fuel contaminated subsurface soils at Sites FT-10C and ST-68
- Treatment of offgas by GAC or more cost-effective means of best available control technology as necessary to comply with ARARS
- Monitoring any thermal treatment effluent for dioxins (at least three sampling events during the first month of operation), and conducting a risk assessment if emissions exceed 200 picograms per dry standard cubic meter

An ESD added excavation to the remedy for Site FT-10C/ST-68 after lead-contaminated soil was discovered in 2002 (AFRPA, 2008b). The RAOs for the lead excavation portion of the remedy are, at a minimum, to eliminate the concentrations incompatible with industrial land use (800 milligrams per kilogram [mg/kg]) and protect water quality in the underlying aquifer at or less than the MCL (15 μg/L) for lead by excavating soil with soluble lead concentrations greater than 15 milligrams per liter (mg/L).

The 2008 ESD anticipated that the excavation effort might result in lead concentrations remaining at the site that are greater than 151 mg/kg, the unrestricted use level established through site-specific determination using DTSC's LEADSPREAD model (AFRPA, 2008b). Therefore, the 2008 ESD stipulated that if residual lead remained at Site FT-10C/ST-68 at concentrations incompatible with unrestricted land use (i.e., lead concentrations remaining at the site that are greater than 151 mg/kg), then ICs would be established by a decision document and implemented to prevent unacceptable risks that may result from disturbance of, and exposure to, lead contaminated soils at this location (AFRPA, 2008b). The excavation occurred in 2008, and no lead concentrations remain at the site greater than 151 mg/kg (MWH, 2009b). In addition, all soluble lead concentrations were less than 15 mg/L (MWH, 2009b). Therefore, ICs related to lead contamination are not required.

An ESD for Site FT-10C/ST-68, finalized in 2010, adds ICs to the remedy at Site FT-10C/ST-68 (AFRPA, 2010b). The ESD replaces the numeric soil cleanup levels for TPH-d and TPH-g with narrative soil cleanup levels.

The RAOs for the ICs are: (1) preventing unacceptable human exposure to soil vapor or residual contamination; (2) protecting the integrity of the remedial system, including the associated monitoring system; and (3) preserving access to the site, the remedial system, and associated monitoring system.

The specific ICs have been documented as environmental restrictive covenants in the deed for the parcel associated with Site FT-10C/ST-68 (Parcel A-1) that has been transferred from Air Force ownership. The transferee is prohibited from:

- Damaging/disturbing/tampering with, or allowing others to damage/disturb/tamper with, the remediation system components, including but not limited to the extraction and injection systems, treatment systems, conveyance pipes, electrical, gas, or fiber optic lines, or monitoring wells, until such time as remediation is complete or components are no longer to be used for remediation

- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of any remediation system component
- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to the site or to any equipment or systems associated with the soil remediation system components

In addition to the ICs identified above, the following ICs are imposed to prevent health risks from exposure to VOC-contaminated shallow soils. The transferee is prohibited from:

- Engaging in any surface or shallow soil disturbance (in the geographic area subject to the IC), until and unless it is demonstrated that VOC contamination at this site is no longer a threat to human health and the environment
- Constructing any structures for human occupation (in the geographic area subject to the IC) without evaluating or addressing the risks posed by vapor intrusion

If the site soil vapor data demonstrate that all soil vapor concentrations for each COC are compatible with unrestricted land use, these ICs will no longer be required by the remedy.

Remedy Implementation. After site investigation and prior to the signing of the Basewide OU ROD, debris and soil (including lead-impacted surface soil) were excavated from Site FT-10C and disposed at the Site LF-04 landfill under a removal action memorandum (AFBCA, 1996c). A remediation system, SVE and/or BV, operated at Site FT-10C/ST-68 from 1997 until 2008. Initially, Site FT-10C/ST-68 underwent SVE of the shallow soils; SVE systems were operated with thermal destruction using a catalytic oxidizer or a GAC system. Samples for dioxins analysis were apparently not collected from the emission of the catalytic oxidizer treatment system as required by the Basewide OU ROD because a report of those results could not be found during the last five-year review or this one. A combination of BV of the shallow soils with SVE of the deep soils was performed between 1998 and 2001, and later in 2001, a thermal SVE system without catalytic oxidation was relocated from Site ST-29 and put into operation. Starting in October 2004 and with SMAQMD concurrence, the SVE system operated without air emission treatment. A new 650-scfm SVE system was installed and operated between May 2005 and August 2008, when the system was permanently shut down. A closure report, finalized in 2010, documented that no further treatment of the vadose zone is necessary at Site FT-10C/ ST-68 (MWH, 2010a), and in 2012, EPA concurrence was received (EPA, 2012c). The SVE/BV system and components were decommissioned in 2012 (ADVENT Environmental, Inc., 2012). Figure 4-13 shows the layout of the former Site FT-10C/ST-68 SVE/BV system, including SVE/BV wells, dual-purpose groundwater monitoring/SVE wells, horizontal SVE/BV wells, and soil vapor monitoring probes/wells.

In 2002, additional lead-contaminated soil and ashy debris were discovered during an excavation by Sacramento County to install a new sewer line along Truemper Way. Consequently, an ESD was prepared to add excavation to the remedy for Site FT-10C/ST-68 (AFRPA, 2008b). In November and December 2008, the lead-contaminated soil was excavated and disposed at an appropriately permitted off-site landfill (MWH, 2009b). Approximately 140 cy of soil were removed from Site FT-10C/ST-68. The soil was excavated such that ICs related to residual lead were not required (i.e., residual lead concentrations met the 151 mg/kg unrestricted use level designated in the ESD).

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. Because all of the Site FT-10C/ST-68 SVE/BV system and components have been decommissioned, the ICs related to protection of those components no longer apply. Figure 4-13 shows the area of Site FT-10C/ST-68 requiring ICs.

In November 2012, the parcel associated with Site FT-10C/ST-68 (Parcel A-1) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010b) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on the ICs before and after property transfer.

4.4.2 Site LF-18

Remedy Selection. The RAO identified in the Basewide OU ROD for Site LF-18 is to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Basewide OU ROD for Site LF-18 includes the following major components:

- Installing an in situ SVE system comprising extraction wells and possibly passive injection wells
- Treatment of offgas by GAC or more cost-effective means of best available control technology as necessary to comply with ARARs
- Monitoring any thermal treatment effluent for dioxins (at least three sampling events during the first month of operation), and conducting a risk assessment if emissions exceed 200 picograms per dry standard cubic meter

An ESD, finalized in 2010, adds ICs to the remedy for Site LF-18 to prevent health risks from exposure to VOC-contaminated soils (AFRPA, 2010b). In addition, because Site LF-18 (including Subsite-OT-23A) was remediated with Soil OU Site SD-59, the protection of SVE piping and wells associated with Site LF-18 was included with the Site SD-59 ICs in the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a). The RAOs and the ICs related to preventing unacceptable human exposure to soil vapor and preserving access to the site and the remedial system are the same as those described in Section 4.4.1 for Site FT-10C/ST-68, and the RAOs and the ICs related to protection of remaining remedial system components and preserving access are the same as those described in Section 4.2.2 for Site ST-37/ST-39/SS-54; therefore, they are not repeated here.

Remedy Implementation. Pilot tests using SVE were conducted at Site LF-18 in 1993, 1995, and 1998 (IT Corporation, 1995a; 1996b; Montgomery Watson, 1999a). The pilot tests confirmed that SVE was effectively able to remove VOCs from the soil at Site LF-18. Therefore, an SVE system was constructed in 1999 and began operation in 2000. In accordance with ROD requirements, three samples for dioxins analysis were collected in February and May 2000 from the emission of the catalytic oxidizer treatment system. Because the results were less than 200 picograms per dry standard cubic meter, conducting a risk assessment was not required (Montgomery Watson, 2000d). Two systems (catalytic oxidizer and GAC) operated concurrently from June 2000 to May 2001. In August 2001, the SVE wells at Site LF-18 were tied into the Site SD-59 manifold. The SVE system could operate with Site LF-18 and/or Site SD-59 vapor extraction wells on line to the system. In November 2008, treatment of vapors from Site LF-18 ceased. A closure report, finalized in 2010, documented that no further treatment of the vadose zone is necessary at Site LF-18 (MWH, 2010b), and in 2012, EPA concurrence was received (EPA, 2012d). The SVE components (wells and piping only) were decommissioned in 2012 (ADVENT Environmental, Inc., 2012). Figure 4-14 shows the layout of the former Site LF-18 SVE system, including SVE wells and soil vapor monitoring probes/wells.

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. Because all of the Site LF-18 SVE components have been decommissioned, the ICs related to protection of those components no longer apply. Figure 4-14 shows the area of Site LF-18 requiring ICs.

In November 2012, the parcel associated with Site LF-18 (Parcel A-1) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010b) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on the ICs before and after property transfer.

4.4.3 Site OT-23C

Remedy Selection. The RAO identified in the Basewide OU ROD for Site OT-23C is to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Basewide OU ROD for Site OT-23C includes the following major components:

- Installing an in situ SVE system comprising extraction wells and passive injection wells
- Treatment of offgas by GAC or more cost-effective means of best available control technology

- Monitoring any thermal treatment effluent for dioxins (at least three sampling events during the first month of operation), and conducting a risk assessment if emissions exceed 200 picograms per dry standard cubic meter

Note that Subsite OT-23A was addressed by the SVE remedial action at Site LF-18, which has been completed, and Subsites OT-23B and OT-23D are addressed by the SVE remedial action at Site ST-37/ST-39/SS-54.

An ESD, finalized in 2010, adds ICs to the remedy at Site OT-23C (AFRPA, 2010b) for the last remaining parcel related to Site OT-23C (Parcel P-2) that had not been previously transferred. Land-use restrictions were imposed as a condition of early transfer for most of the land associated with Site OT-23; the remaining parcel transferred after ICs were added to the remedy is on the margin of the site and the ICs are only necessary there to protect one monitoring well. The RAOs for the ICs are: (1) preventing unacceptable human exposure to soil vapor or residual contamination; (2) protecting the integrity of the remedial systems, including the associated monitoring system; and (3) preserving necessary access to the remedial system(s), and associated monitoring system.

The specific ICs have been documented as environmental restrictive covenants in the deed and restrictions/prohibitions in the SLUC for the last parcel associated with Site OT-23C (Parcel P-2) that was transferred from Air Force ownership. The transferee is prohibited from:

- Damaging/disturbing/tampering with, or allowing others to damage/disturb/tamper with, the remediation system components, including but not limited to the extraction and injection systems, treatment systems, conveyance pipes, electrical, gas, or fiber optic lines, or monitoring wells, until such time as remediation is complete or components are no longer to be used for remediation

- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of any remediation system component

- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to the site or to any equipment or systems associated with the soil remediation system components

In addition to the ICs identified above, the following ICs are imposed to prevent health risks from exposure to VOC-contaminated shallow soils. The transferee is prohibited from:

- Engaging in any surface or shallow soil disturbance (in the geographic area subject to the IC), until and unless it is demonstrated that VOC contamination at this site is no longer a threat to human health and the environment

- Constructing any structures for human occupation (in the geographic area subject to the IC) without evaluating or addressing the risks posed by vapor intrusion

If the site soil vapor data demonstrate that all soil vapor concentrations for each COC are compatible with unrestricted land use, these ICs will no longer be required by the remedy.

Remedy Implementation. Two phases of post-ROD characterization were conducted at Site OT-23C, which included installation of multi-probe SVMPs and SVE wells and a pilot test of the SVE system beginning in 1999. Full-scale operations began in April 2000 with catalytic oxidation treatment and continued until January 2002 when treatment was converted to GAC. In accordance with ROD requirements, three samples for dioxins analysis were collected in June 2000 from the emission of the catalytic oxidizer treatment system. Because the results were less than 200 picograms per dry standard cubic meter, conducting a risk assessment was not required (Montgomery Watson, 2000d). As of October 2014, the Site OT-23C SVE remedial system includes a 350-cubic feet per minute (cfm) vacuum extraction system and two 3,000-pound GAC vessels in series for air contaminant emissions abatement.

Figure 4-15 shows the layout of the Site OT-23C SVE system, including SVE wells and soil vapor monitoring probes/wells to monitor vapor concentrations and remedial progress at the site. Appendix A provides the operational and remedial history for the Site OT-23C remedial system.

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2013, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. Figure 4-15 shows the area of Site OT-23C requiring ICs.

In January 2013, the remaining parcel associated with Site OT-23C (Parcel P-2) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010b) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. In May 2013, a SLUC was executed for this parcel; therefore, the new property owner is required to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer.

4.4.4 Operations and Maintenance

During the period of this five-year review, the SVE treatment system for Basewide OU Site OT-23C described in Section 4.4.3 was operated in accordance with the *Soil Vapor Extraction and Bioventing Remedial Treatment Systems Operations and Maintenance Manual for Sites 7/11, 10C/68, 23C, 29/71, 37/39/54, 57, and 18/59* (MWH, 2009d). A combination of routine weekly, monthly, quarterly, semiannual, and annual O&M activities are conducted for the SVE treatment systems. Specific O&M tasks are outlined in the various O&M manuals.

4.4.5 Site OT-87

Remedy Selection. Although no specific RAOs are identified in the Basewide OU ROD for Site OT-87, the basis for cleanup is protection of human health, groundwater quality, surface-water quality, and ecological receptors.

The remedial action selected in the Basewide OU ROD for Site OT-87 includes the following major components:

- Excavating approximately 28,000 cy of contaminated sediments and surface soils to a 6-inch depth through the fall zone of the lead shot.
- Stabilizing (if needed for disposal) approximately 28,000 cy of contaminated sediments and surface soils.

- Constructing diversion dams to channel water flow away from areas to be excavated, if any surface water is present. These dams would be removed following completion of the excavation activities. If diversion dams are not appropriate, the water will be discharged to the publicly owned treatment works, if approved by Sacramento County.

- Transporting the soil, stabilized as necessary, to Site WP-07 for use as foundation material in construction of a cap, or an off-base facility if sample screening indicates that Site WP-07 acceptance criteria are not met.

- Backfilling the excavated areas with uncontaminated soils and/or recontouring to create effective drainage.

- Implementing ICs with the goal of protecting human health.

The Basewide OU ROD also requires monitoring to insure that the residual levels of lead left in place at Site OT-87 do not pose a hazard to small mammals and waterfowl. To accomplish this task, monitoring of lead levels in small mammal tissue is required on an annual basis for 3 years, with the results evaluated in an annual monitoring report to the regulatory agencies. In addition, any dead waterfowl found in the area of Site 87 must be reported to the regulatory agencies, and necropsied by a certified laboratory for signs of lead toxicity. The details of the monitoring program are to be worked out cooperatively between the Air Force and the regulatory agencies.

If small mammal tissue lead levels are less than those reported to cause adverse effects (Eisler, 1998) after a minimum of 2 years of monitoring, then monitoring will be discontinued upon agreement by the regulatory agencies. If small mammal tissue lead levels are higher than those reported to cause adverse effects (Eisler, 1998) after a minimum of 2 years of monitoring, further ecological investigation and re-evaluation of the lead cleanup level will be conducted. The Air Force may have to undertake additional remedial action to reduce lead levels at Site OT-87.

If necropsied waterfowl show evidence of adverse effects due to ingestion of lead, further ecological investigation and re-evaluation of the lead cleanup level will be conducted. The Air Force may have to undertake additional remedial action to reduce lead levels at Site OT-87.

Regarding ICs at Site OT-87, the Basewide OU ROD stated, “institutional controls will be implemented with the goal of protecting human health,” and provided as a reason, “institutional controls provide further protection of human health and the environment” (AFBCA, 1998c). Consequently, an ESD, finalized in 2010, clarifies the implementation of ICs at Site OT-87 (AFRPA, 2010b).

The RAO for the ICs is to prevent unacceptable human exposure to residual lead contamination at Site OT-87. The specific ICs will be documented as environmental restrictive covenants in deeds and restrictions/prohibitions in SLUCs. The transferee will be prohibited from:

- Engaging in any surface or shallow soil disturbance activities at Site OT-87, where it may contain elevated lead concentrations, without prior approval from the ROD signatory agencies to ensure that the activity will not compromise protection of human health and the environment. This includes any activities that would alter drainage or sub-drainage in the area

- Using, or allowing others to use, Site OT-87 for residential development, or construction of schools, day care facilities for children, or hospitals for human care, and that any uses of the site that would allow exposure to the buried contaminated soils by the public will be prohibited

Remedy Implementation. Remediation activities at Site OT-87 commenced in August 1998 and were finished when site restoration was completed in July 1999 (Montgomery Watson, 1999f). Approximately 1,100 excavated cy of a clay shard/soil mixture were excavated and treated at the site and then transported to Site WP-07. The majority of the PAH-impacted excavated soil, approximately 9,570 cy, met Site WP-07 acceptance criteria and was directly transported to Site WP-07. An additional estimated 730 cy of soil removed from the PAH-impacted area had total lead concentrations exceeding the Site WP-07 acceptance criteria. This material was treated on site and then transported to Site WP-07. The total volume of lead-impacted sediments excavated from the site was 4,540 cy. Of that material, approximately 2,150 cy were treated due to high lead concentrations. The treated material, as well as the additional 2,390 cy excavated (not treated) material, were transported to Site WP-07. The total volume of lead-impacted soil excavated from the site (not including soil from the PAH-impacted area) and treated was approximately 14,000 cy. The treated soil was characterized at Site OT-87 and transported to Site WP-07 once the Site WP-07 acceptance criteria had been met. All material transported to Site WP-07 was used as foundation material for the landfill cap. All recovered spent bullets and shot from the density separation activities, approximately 57,000 pounds, were sent to A-1 Metals in Sacramento for recycling of the lead. Based on the field observations and analytical results of the confirmation samples, the cleanup levels specified in the ROD were met. In addition, site restoration, including backfilling, grading, and hydroseeding, was completed at the site. No further cleanup action is planned at Site OT-87. An RAR was finalized in September 2009 (AFRPA, 2009b) and received EPA concurrence (EPA, 2009). Figure 4-16 shows the approximate extent of soil excavation.

Small mammal monitoring was initiated in 2007 and was completed in 2009. No small mammals were trapped at Site OT-87 in 2007. The results of the 2008 sampling were reported in the *Results of 2008 Small Mammal Monitoring at Site 87* (MWH, 2009e), and the results of the 2009 sampling were reported in the *Results of 2009 Small Mammal Monitoring at Site 87* (MWH, 2010c). The Air Force concluded that residual lead concentrations in soil do not indicate the potential for adverse effects on small mammal populations and discontinued small mammal monitoring at Site OT-87.

The Basewide OU ROD also requires evaluation of any dead waterfowl found at the site. Through September 2014, no dead waterfowl have been observed at Site OT-87.

During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2013, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. Figure 4-16 shows the area of Site OT-87 requiring ICs.

Use restrictions were implemented during the review period through Air Force ownership of the land, and through the terms of the lease to Sacramento County for use of the land as a regional park. When the ownership of the property is transferred to the county from the DOI, the ICs will be incorporated in the deed or other transactional documents. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer.

4.5 OU 6 (Supplemental Basewide OU)

4.5.1 Site OT-89

Remedy Selection. The RAOs identified in the Supplemental Basewide OU ROD for Site OT-89 are: (1) prevent unrestricted human exposure to lead concentrations greater than 192 mg/kg; (2) prevent plant exposure to lead concentrations greater than 700 mg/kg; and (3) prevent disturbance of subsurface soil that could threaten water quality.

The remedy selected in the Supplemental Basewide OU ROD for Site OT-89 is ICs. The specific ICs have been documented as environmental restrictive covenants in the deed for the parcel associated with Site OT-89 (Parcel A-1) that has been transferred from Air Force ownership. The transferee is prohibited from:

- Engaging in any surface or shallow soil disturbance activities at Site OT-89 (including any activities that would alter drainage, or sub-drainage, in the area), until and unless it is demonstrated that the lead concentrations in the soils at this site are no longer a threat to human health and the environment

- Using, or allow others to use, Site OT-89 for residential purposes (including mobile or modular homes), hospitals for human care, public or private schools for persons under 18 years of age, nursery schools, or for daycare centers for children

Removal Implementation. Prior to the signing of the Supplemental Basewide OU ROD, a pilot study was conducted at Site OT-89 during the remedial action for Site OT-87 (Basewide OU) to determine whether lead stabilization of the soil from Site OT-89, using the same stabilization technology as at Site OT-87, was effective in reducing soluble lead concentrations in soil (Montgomery Watson, 2000b). Approximately 650 cy of lead-contaminated soils were excavated and transported to Site OT-87 for treatment. Recoverable lead shot was removed and sent to A-1 Metals in Sacramento for recycling. The soil was successfully stabilized with a cement additive and then transported to Site WP-07 to be used as foundation material for the landfill cap. These pilot study activities were completed in July 1999.

Excavation of contaminated sediment was conducted as part of a time-critical removal action for Site OT-89 (AFBCA, 2001b; MWH, 2002a). Excavation activities commenced in July 2001 and were completed in December 2001. Approximately 300 cy of soil were excavated and disposed at an appropriately permitted off-site landfill. Based on confirmation sample results, the removal cleanup goals specified in the removal action memorandum were achieved (AFBCA, 2001b). These removal cleanup goals are protective of human health under an occupational exposure scenario and protective of the environment. However, because the residual buried lead in the southwestern shot-fall area is not known to be compatible with unrestricted (i.e., residential) land use, land-use restrictions are required to be protective of human health.

Figure 4-17 shows the approximate extent of the pilot study and removal action soil excavations.

Remedy Implementation. ICs have been implemented at Site OT-89 in accordance with the Supplemental Basewide OU ROD to prevent unacceptable exposure to surface and subsurface lead contamination. During the period of this five-year review, the following IC inspections were conducted to ensure that ICs are maintained and enforced:

- In 2010, covering the period September 2006 through August 2010 (AFRPA, 2010c)

- In 2012, covering the period August 2010 through January 2012 (URS, 2012b)

- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. Figure 4-17 shows the area of Site OT-89 requiring ICs.

In November 2012, the parcel associated with Site OT-89 (A-1) was transferred from Air Force ownership, and the deed restriction language in the Supplemental Basewide OU ROD (AFRPA, 2006) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on the ICs before and after property transfer.

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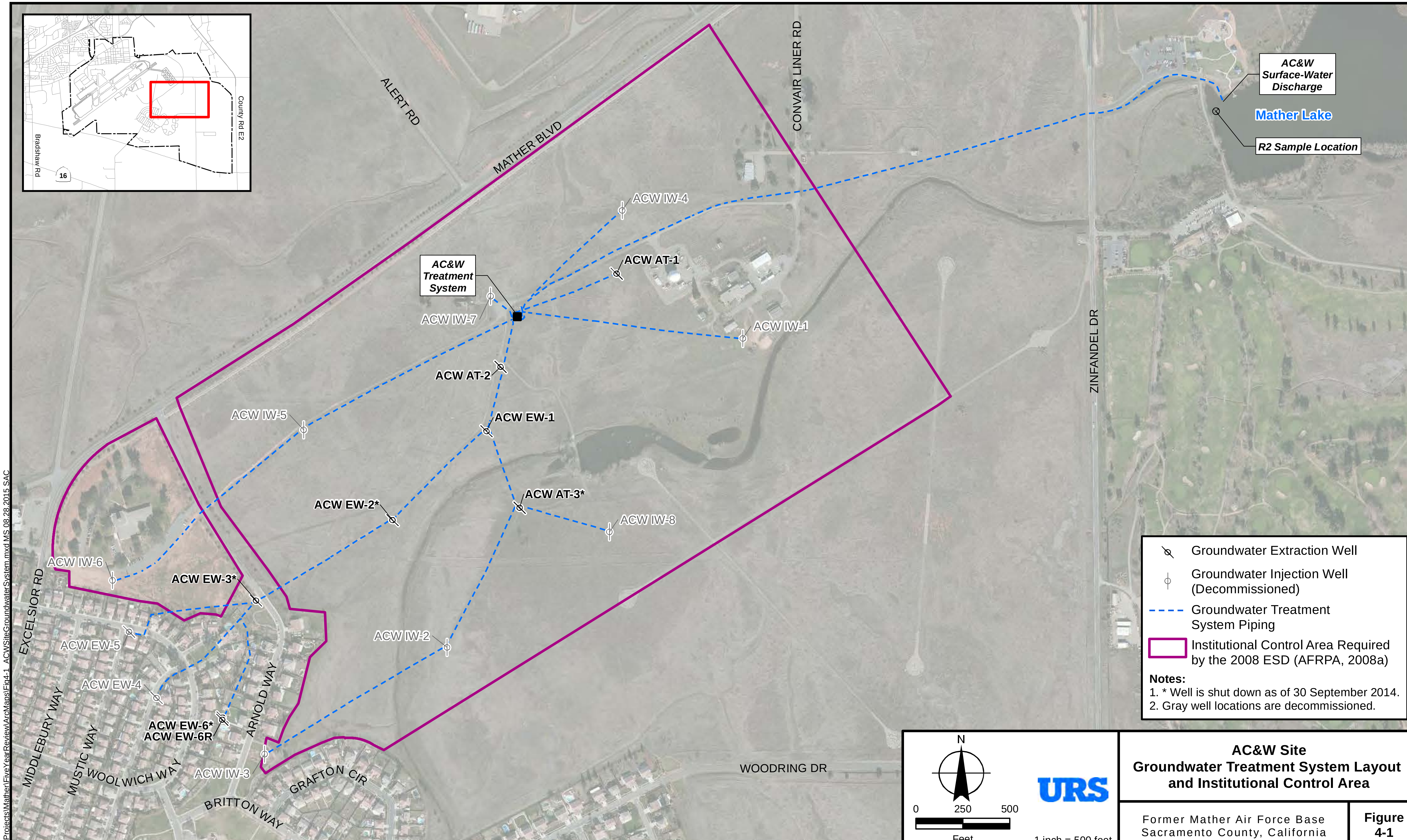
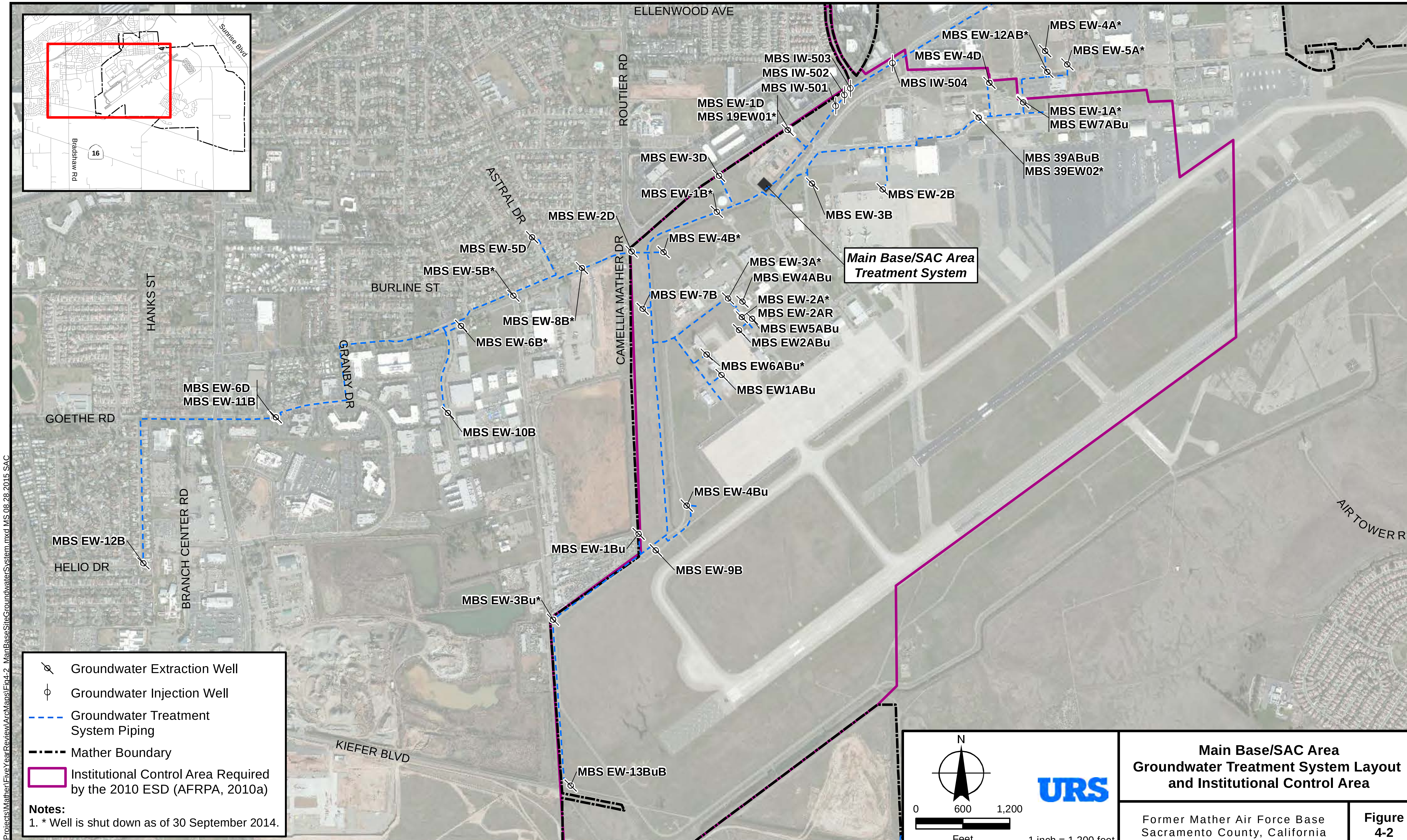


AC&W Site
Groundwater Treatment System Layout and Institutional Control Area

Former Mather Air Force Base
Sacramento County, California

Figure 4-1


ELLENWOOD AVE
ROUTIER RD
ASTRAL DR
BURLINE ST
HANKS ST
GRANBY DR
CAMELLIA MATHER DR
GOETHE RD
HELIO DR
BRANCH CENTER RD
KIEFER BLVD
AIR TOWER RD
Sunrise Blvd
Bradshaw Rd
16
MBS EW-12AB*
MBS EW-4A*
MBS EW-5A*
MBS EW-4D
MBS IW-503
MBS IW-502
MBS IW-501
MBS IW-504
MBS EW-1D
MBS 19EW01*
MBS EW-1A*
MBS EW7ABu
MBS 39ABuB
MBS 39EW02*
MBS EW-3D
MBS EW-1B*
MBS EW-2B
MBS EW-3B
MBS EW-2D
MBS EW-4B*
MBS EW-5D
MBS EW-5B*
Main Base/SAC Area Treatment System
MBS EW-3A*
MBS EW4ABu
MBS EW-7B
MBS EW-2A*
MBS EW-2AR
MBS EW5ABu
MBS EW2ABu
MBS EW-8B*
MBS EW-6B*
MBS EW6ABu*
MBS EW1ABu
MBS EW-6D
MBS EW-11B
MBS EW-10B
MBS EW-4Bu
MBS EW-12B
MBS EW-1Bu
MBS EW-9B
MBS EW-3Bu*
MBS EW-13BuB
Groundwater Extraction Well
Groundwater Injection Well
Groundwater Treatment System Piping
Mather Boundary
Institutional Control Area Required by the 2010 ESD (AFRPA, 2010a)
Notes:
1. * Well is shut down as of 30 September 2014.
N
0 600 1,200
Feet
1 inch = 1,200 feet
URS
Main Base/SAC Area Groundwater Treatment System Layout and Institutional Control Area
Former Mather Air Force Base
Sacramento County, California
Figure 4-2
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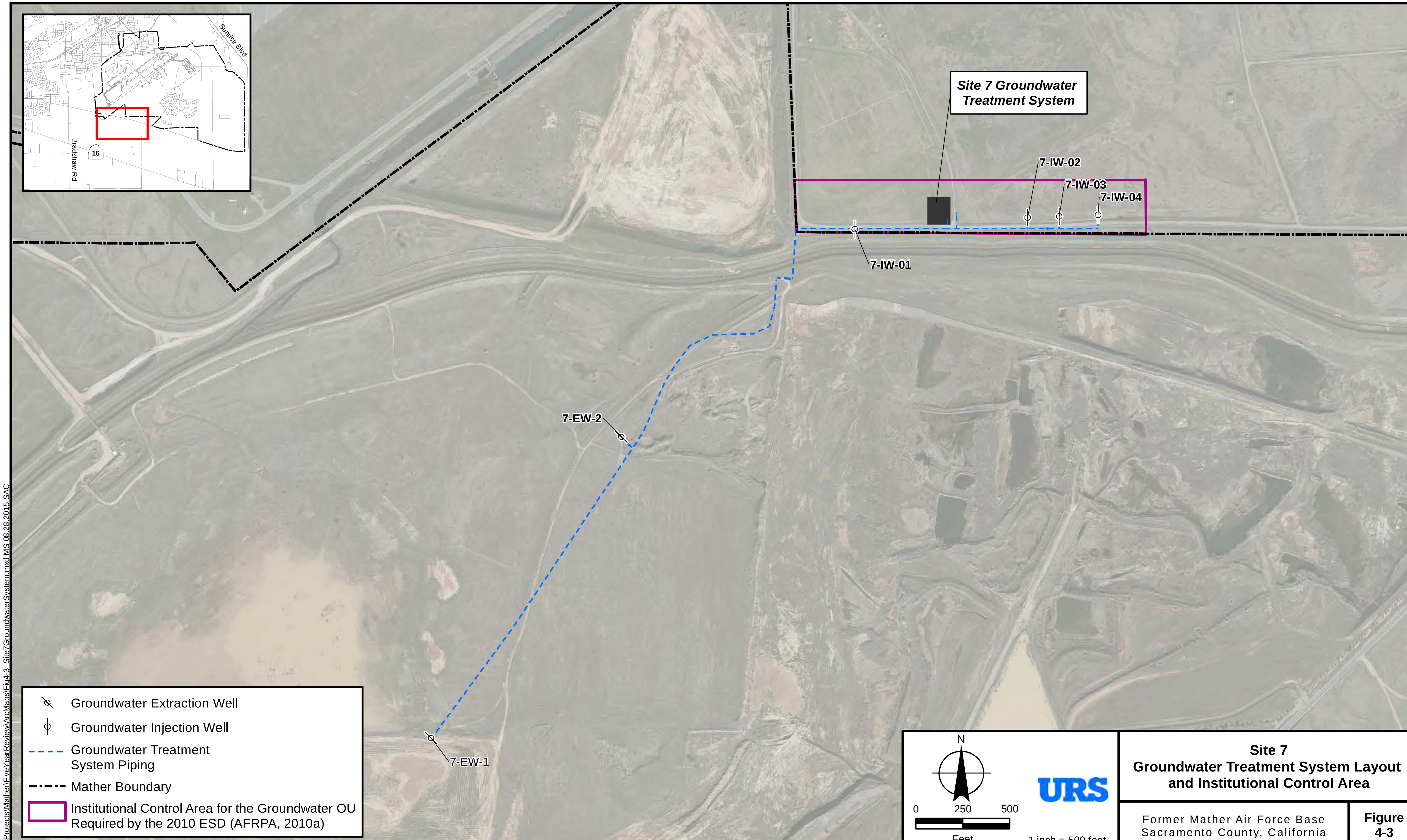
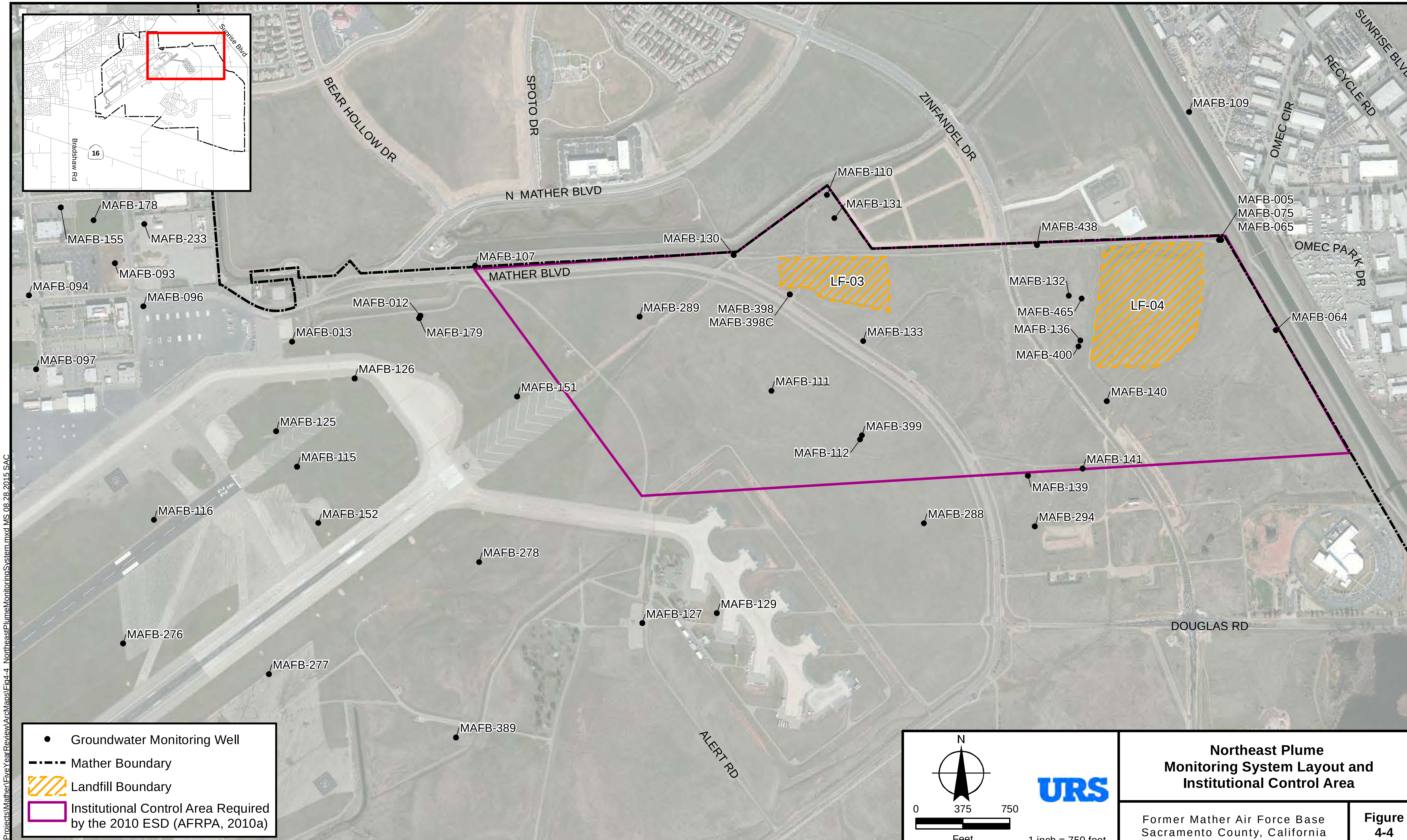


Site 7
Groundwater Treatment System Layout and Institutional Control Area

Former Mather Air Force Base
Sacramento County, California

Figure 4-3


Northeast Plume
Monitoring System Layout and
Institutional Control Area
Former Mather Air Force Base
Sacramento County, California
Figure 4-4
URS
Groundwater Monitoring Well
Mather Boundary
Landfill Boundary
Institutional Control Area Required by the 2010 ESD (AFRPA, 2010a)
0 375 750
Feet
1 inch = 750 feet
N
LF-03
LF-04
MATHER BLVD
N MATHER BLVD
BEAR HOLLOW DR
SPOTO DR
ZINFANDEL DR
SUNRISE BLVD
RECYCLE RD
OMEC CIR
OMEC PARK DR
DOUGLAS RD
ALERT RD
MAFB-005
MAFB-075
MAFB-065
MAFB-064
MAFB-109
MAFB-110
MAFB-131
MAFB-130
MAFB-438
MAFB-107
MAFB-178
MAFB-155
MAFB-233
MAFB-093
MAFB-094
MAFB-096
MAFB-012
MAFB-179
MAFB-013
MAFB-097
MAFB-126
MAFB-151
MAFB-289
MAFB-398
MAFB-398C
MAFB-133
MAFB-132
MAFB-465
MAFB-136
MAFB-400
MAFB-111
MAFB-140
MAFB-125
MAFB-399
MAFB-112
MAFB-115
MAFB-141
MAFB-139
MAFB-116
MAFB-152
MAFB-288
MAFB-294
MAFB-278
MAFB-127
MAFB-129
MAFB-276
MAFB-277
MAFB-389
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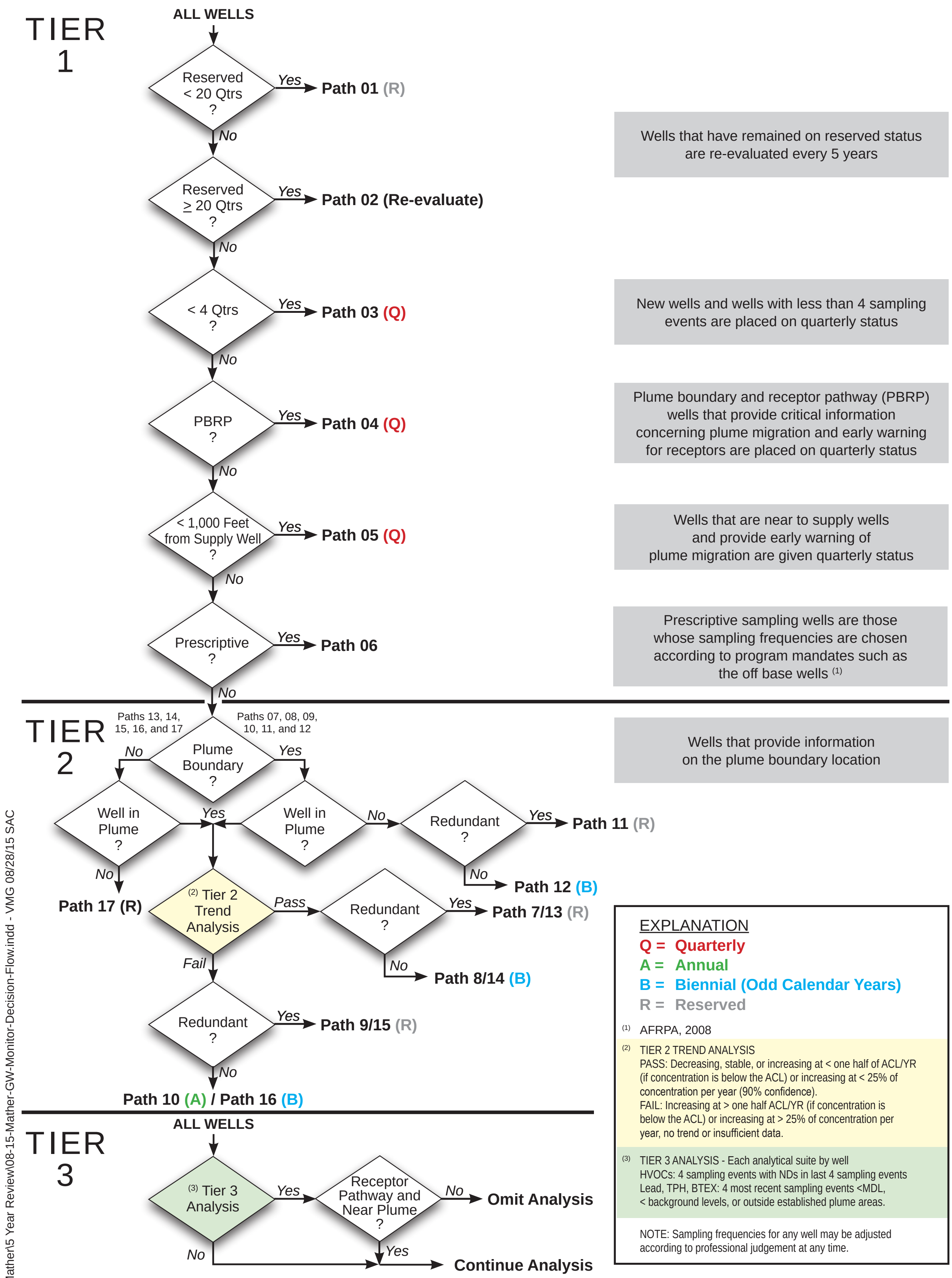
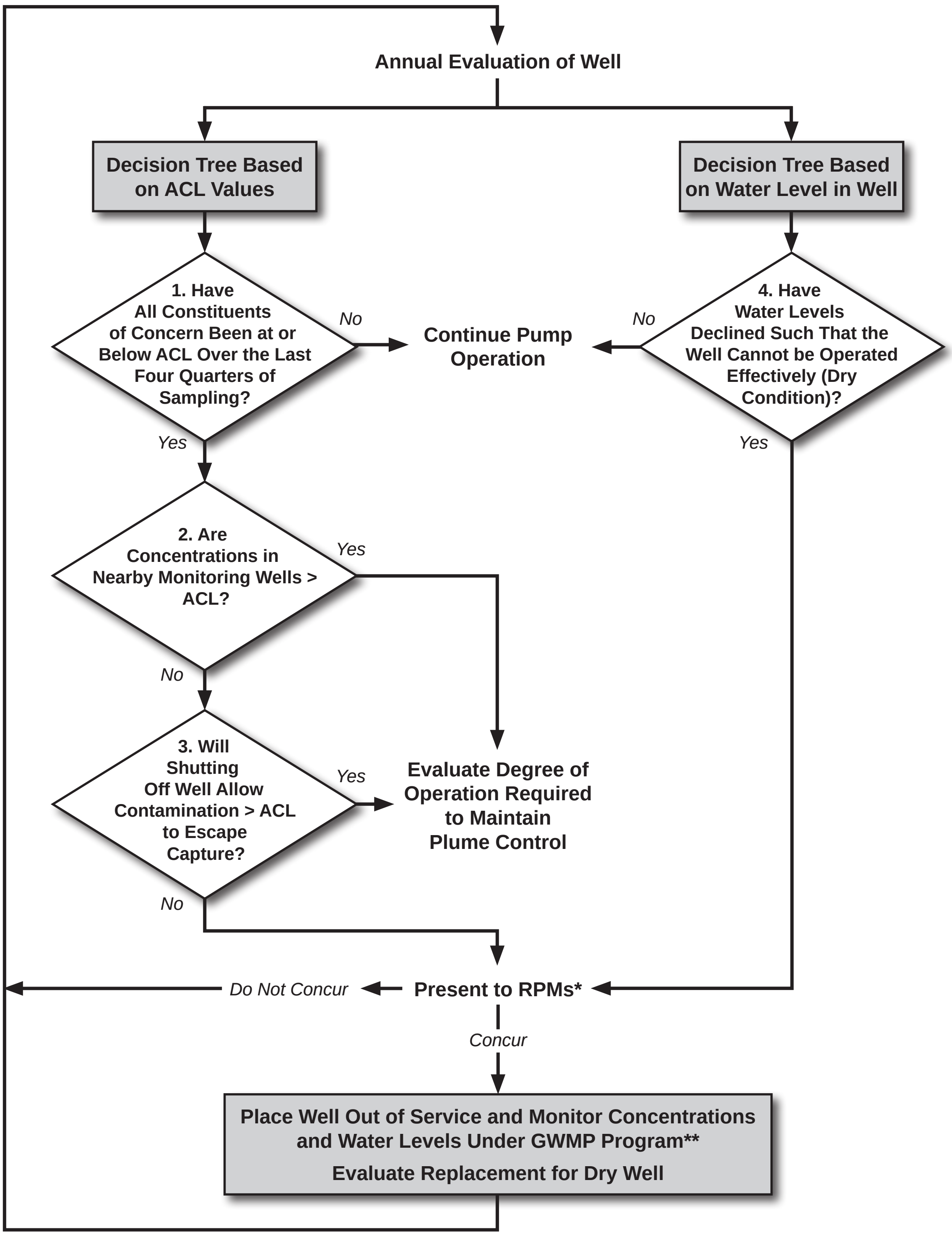


Figure 4-5. Groundwater Monitoring Decision Tree, Former Mather Air Force Base, Sacramento County, California



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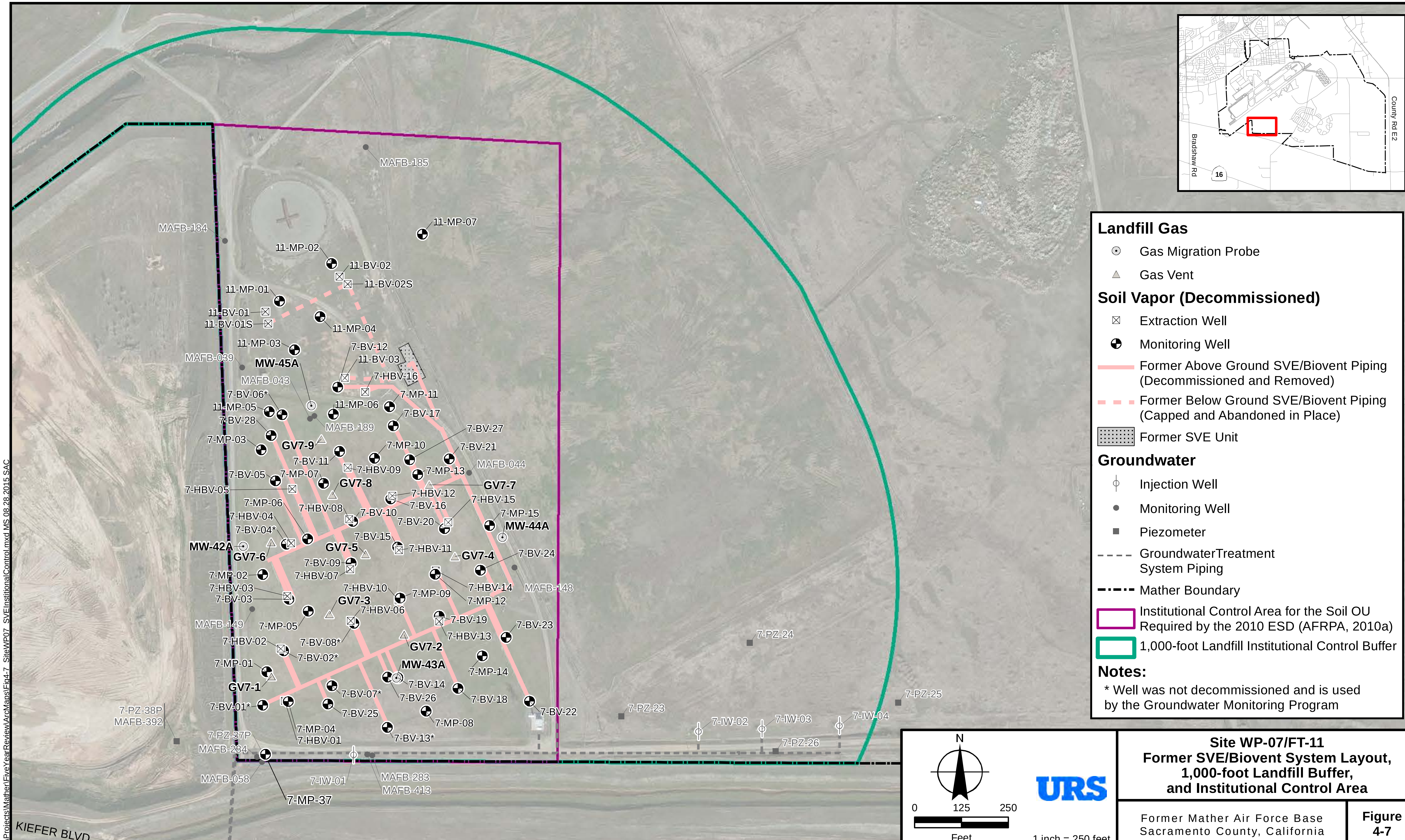
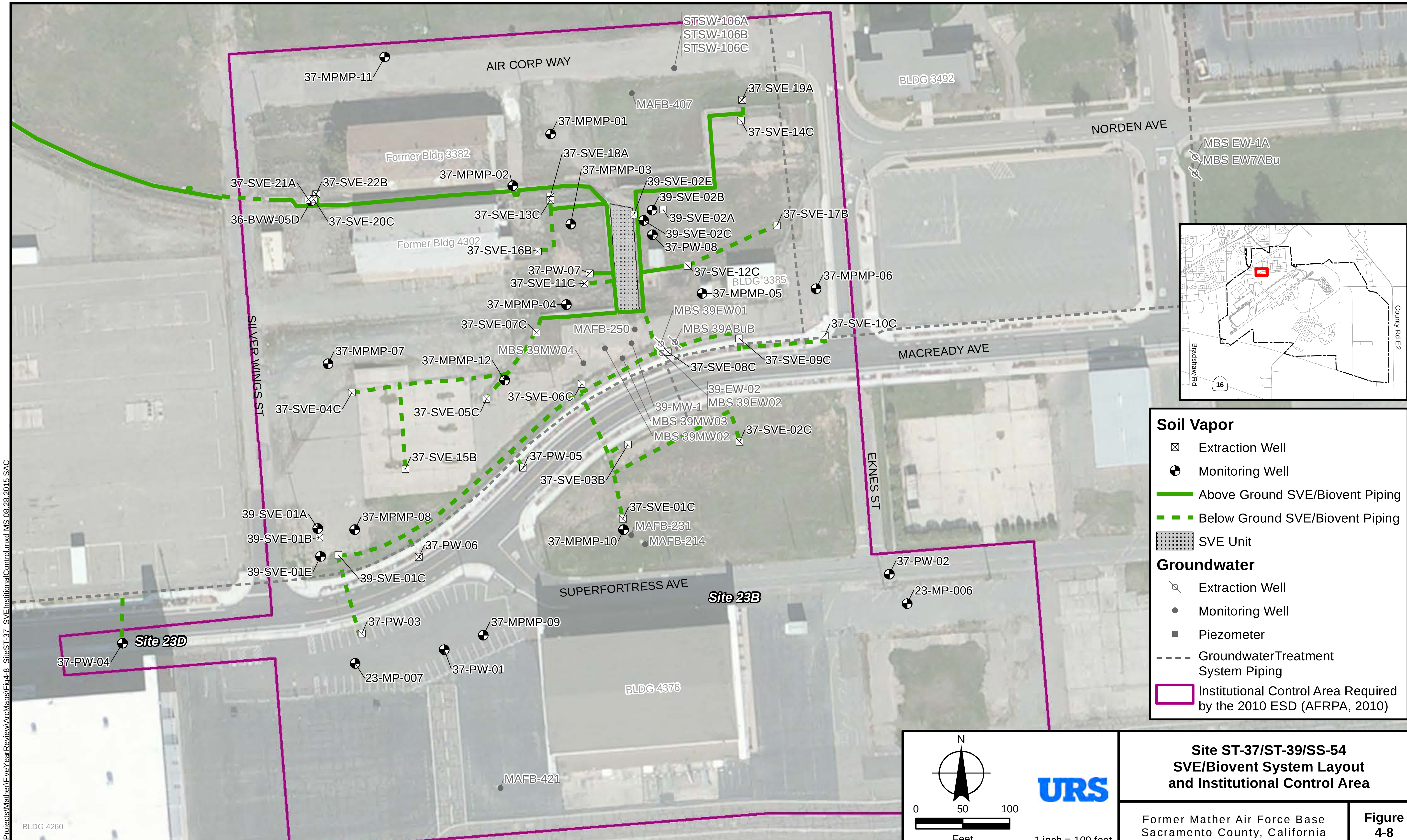
Notes:

* *RPMs may override decision criteria by mutual agreement.*

** *Extended cleanup times or other economic considerations may override well shut off decision.*

Figure 4-6. Extraction Well Shutdown Decision Tree, Former Mather Air Force Base, Sacramento County, California

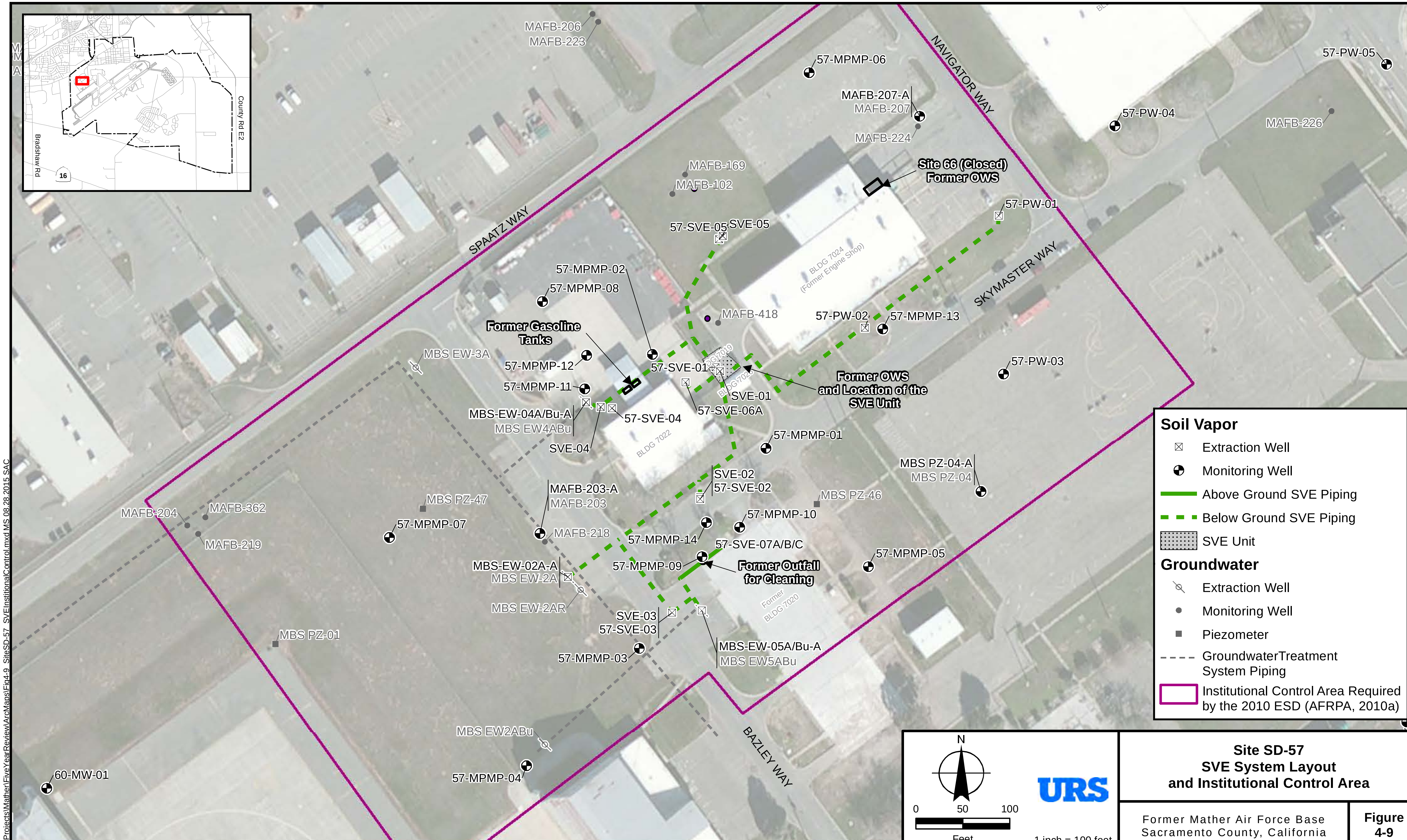

Landfill Gas
Gas Migration Probe
Gas Vent
Soil Vapor (Decommissioned)
Extraction Well
Monitoring Well
Former Above Ground SVE/Biovent Piping (Decommissioned and Removed)
Former Below Ground SVE/Biovent Piping (Capped and Abandoned in Place)
Former SVE Unit
Groundwater
Injection Well
Monitoring Well
Piezometer
GroundwaterTreatment System Piping
Mather Boundary
Institutional Control Area for the Soil OU Required by the 2010 ESD (AFRPA, 2010a)
1,000-foot Landfill Institutional Control Buffer
Notes:
* Well was not decommissioned and is used by the Groundwater Monitoring Program
Site WP-07/FT-11
Former SVE/Biovent System Layout,
1,000-foot Landfill Buffer,
and Institutional Control Area
Former Mather Air Force Base
Sacramento County, California
Figure 4-7
URS
0 125 250
Feet
1 inch = 250 feet
KIEFER BLVD
Bradshaw Rd
County Rd E2
16



Site ST-37/ST-39/SS-54
SVE/Biovent System Layout
and Institutional Control Area

Former Mather Air Force Base
Sacramento County, California

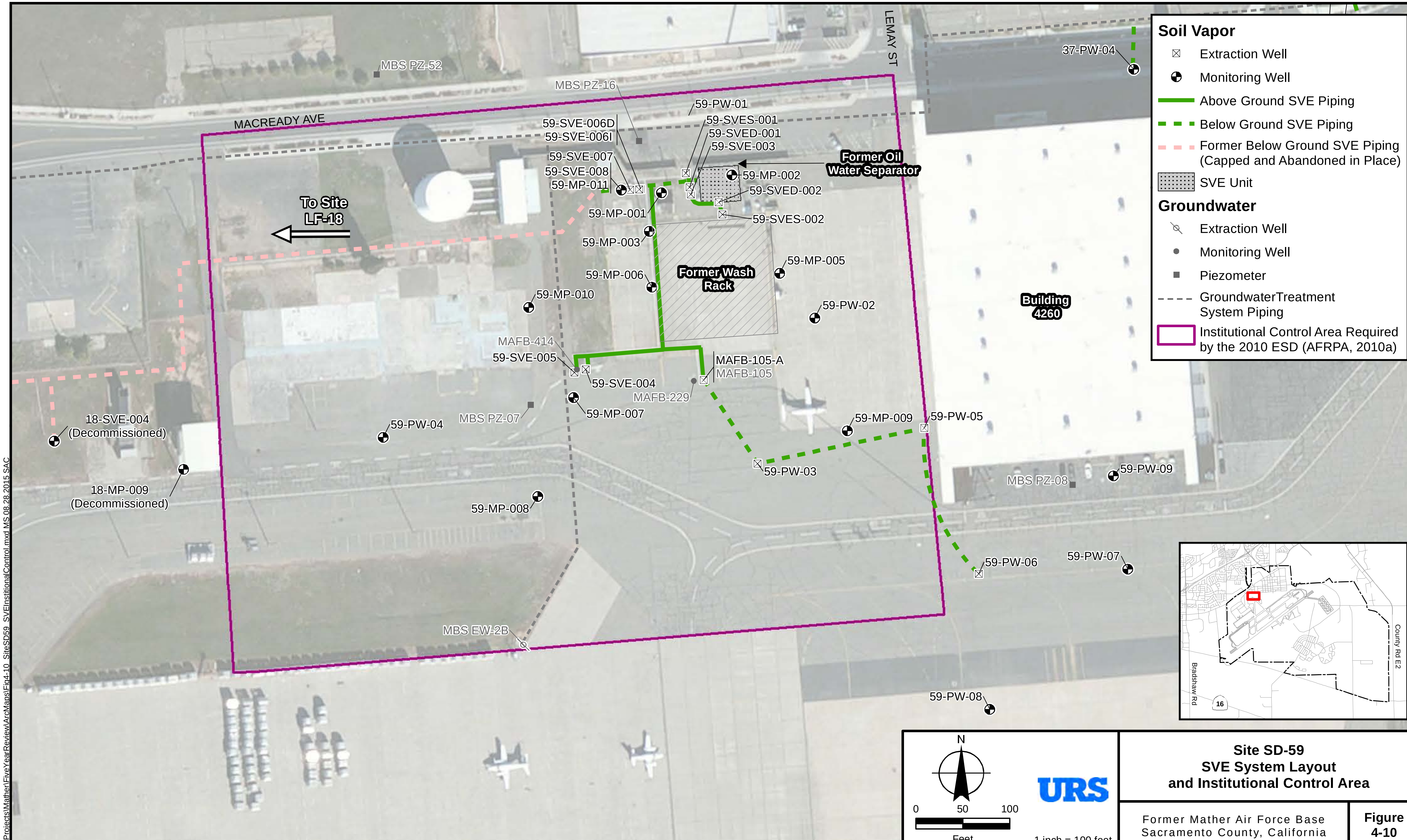
Figure 4-8

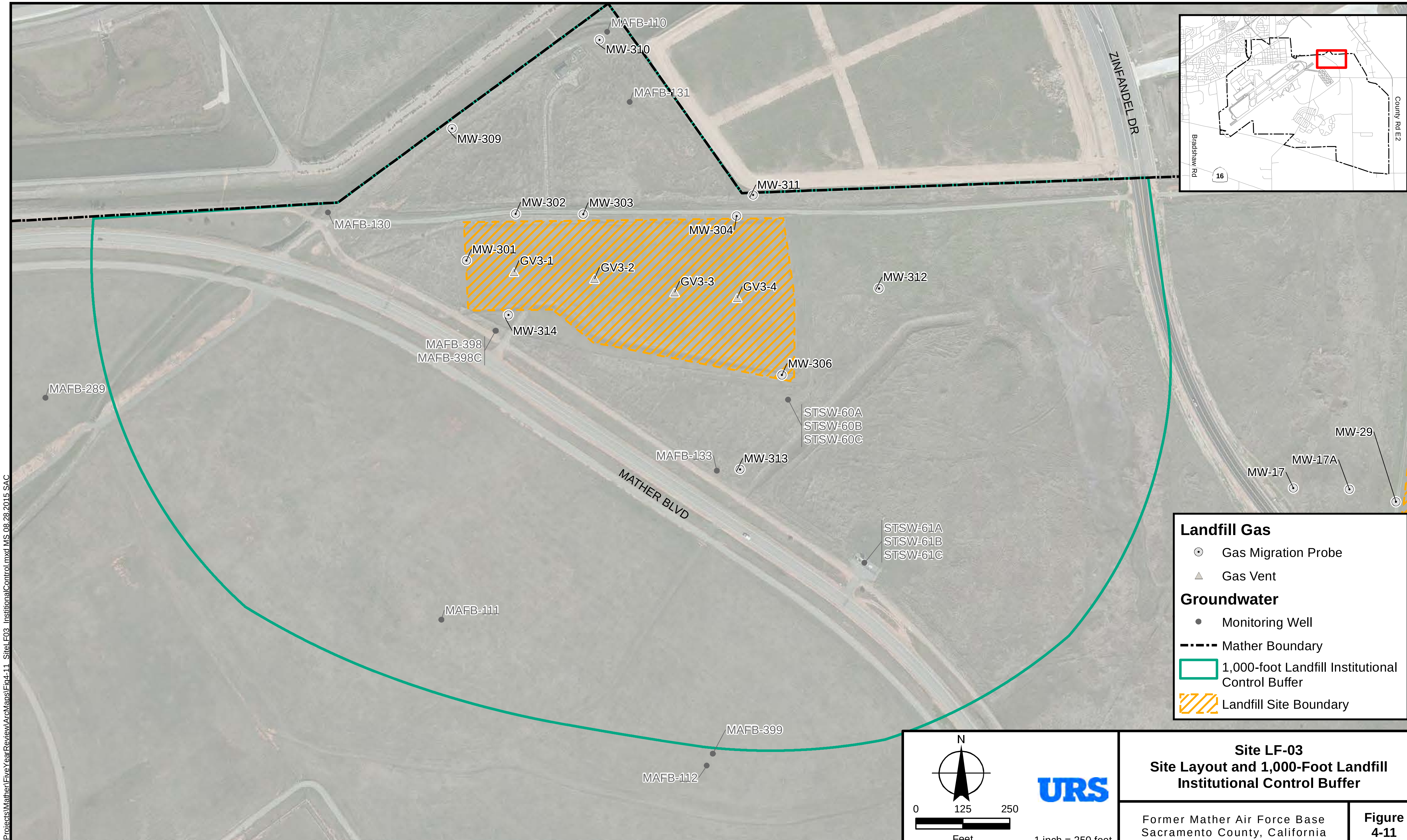


Site SD-57
SVE System Layout
and Institutional Control Area

Former Mather Air Force Base
Sacramento County, California

Figure 4-9

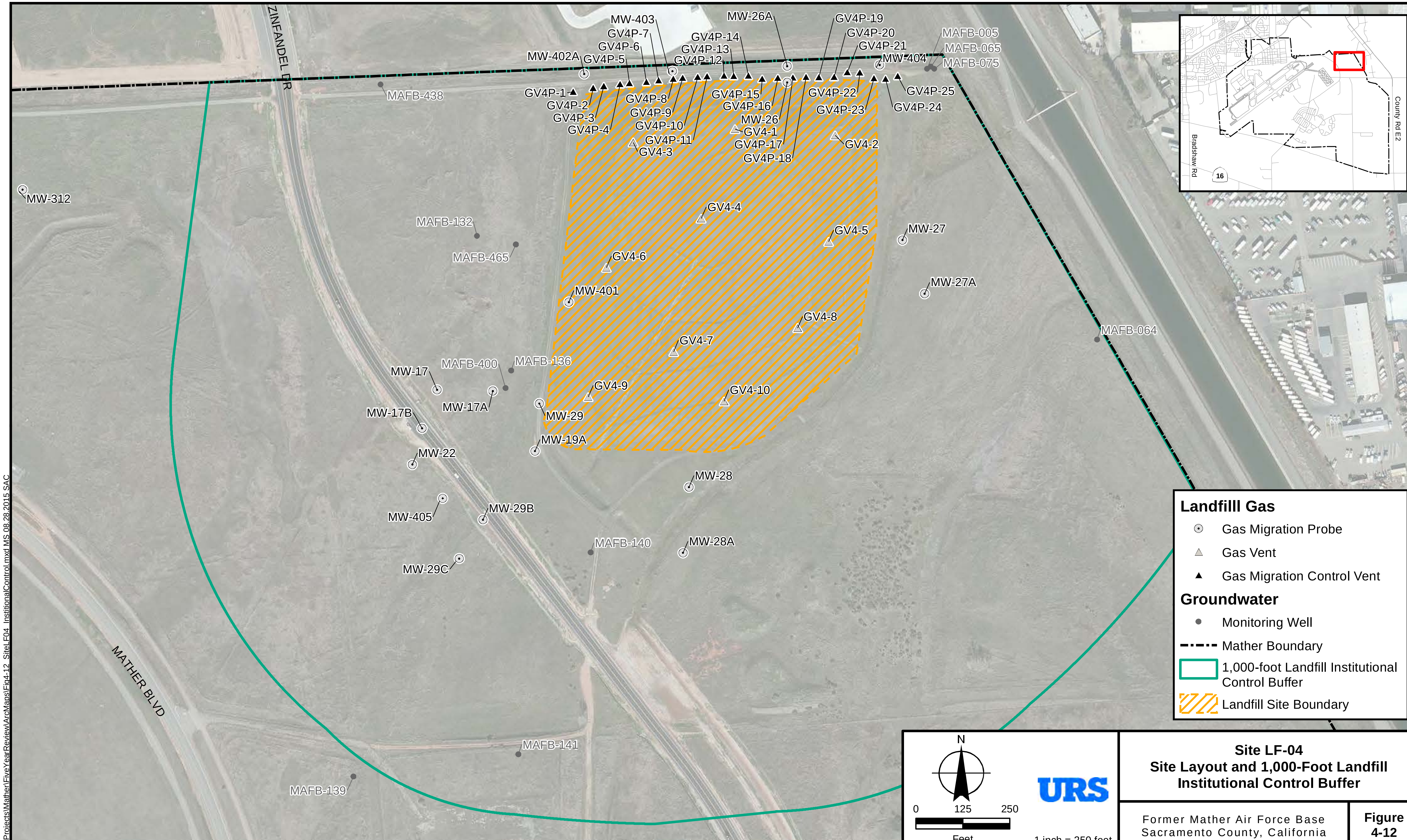

Soil Vapor
Extraction Well
Monitoring Well
Above Ground SVE Piping
Below Ground SVE Piping
Former Below Ground SVE Piping (Capped and Abandoned in Place)
SVE Unit
Groundwater
Extraction Well
Monitoring Well
Piezometer
GroundwaterTreatment System Piping
Institutional Control Area Required by the 2010 ESD (AFRPA, 2010a)
MACREADY AVE
LEMAY ST
To Site LF-18
Former Oil Water Separator
Former Wash Rack
Building 4260
MBS PZ-52
MBS PZ-16
MBS PZ-07
MBS PZ-08
MBS EW-2B
37-PW-04
59-PW-01
59-SVE-006D
59-SVE-006I
59-SVES-001
59-SVED-001
59-SVE-003
59-SVE-007
59-SVE-008
59-MP-011
59-MP-002
59-SVED-002
59-MP-001
59-SVES-002
59-MP-003
59-MP-005
59-MP-006
59-MP-010
59-PW-02
MAFB-414
59-SVE-005
MAFB-105-A
MAFB-105
59-SVE-004
MAFB-229
59-MP-007
59-PW-04
59-MP-009
59-PW-05
18-SVE-004 (Decommissioned)
18-MP-009 (Decommissioned)
59-PW-03
59-PW-09
59-MP-008
59-PW-06
59-PW-07
59-PW-08
County Rd E2
Bradshaw Rd
16
N
0 50 100
Feet
1 inch = 100 feet
URS
Site SD-59
SVE System Layout
and Institutional Control Area
Former Mather Air Force Base
Sacramento County, California
Figure 4-10



Site LF-03
Site Layout and 1,000-Foot Landfill Institutional Control Buffer

Former Mather Air Force Base
Sacramento County, California

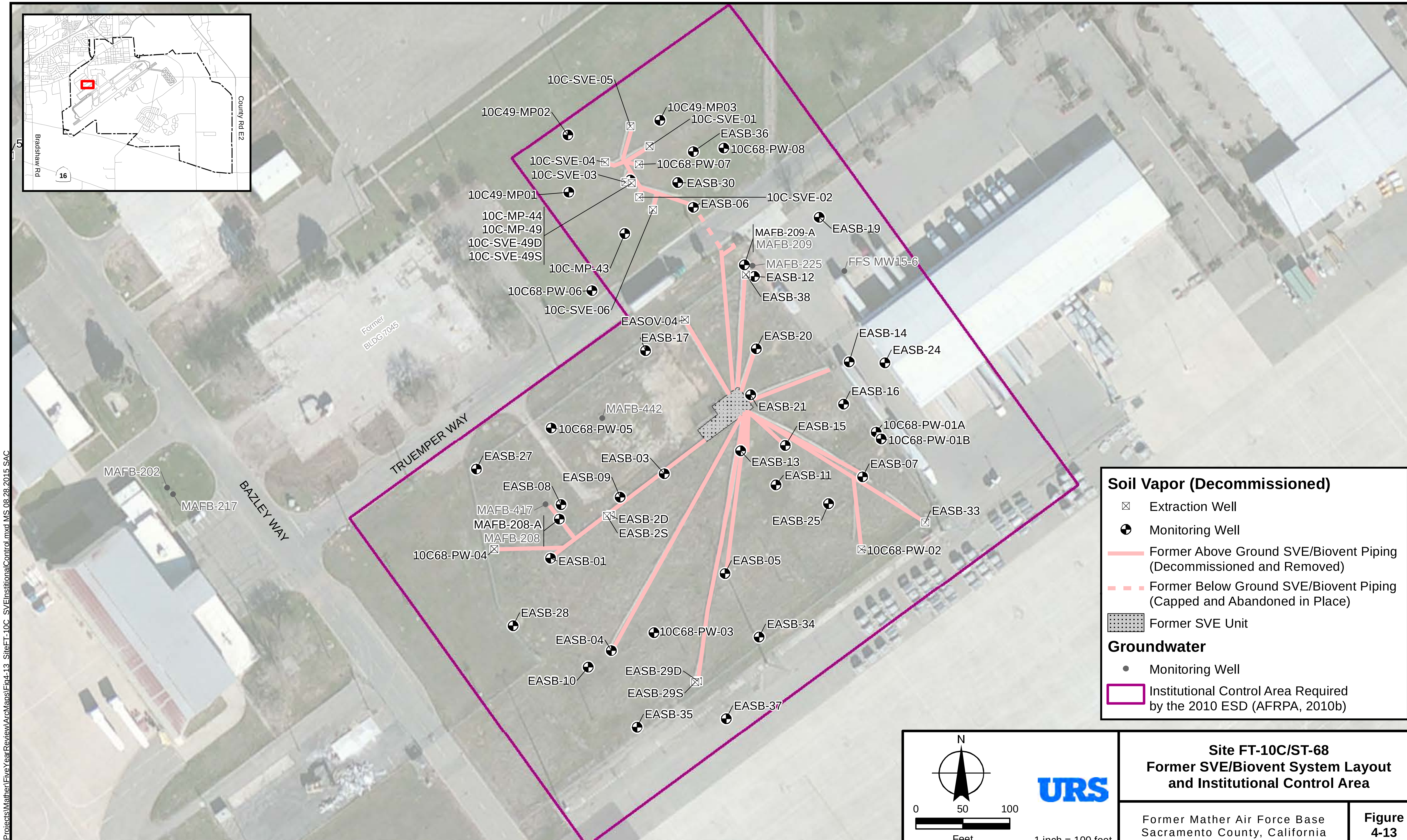
Figure 4-11



Site LF-04
Site Layout and 1,000-Foot Landfill Institutional Control Buffer

Former Mather Air Force Base
Sacramento County, California

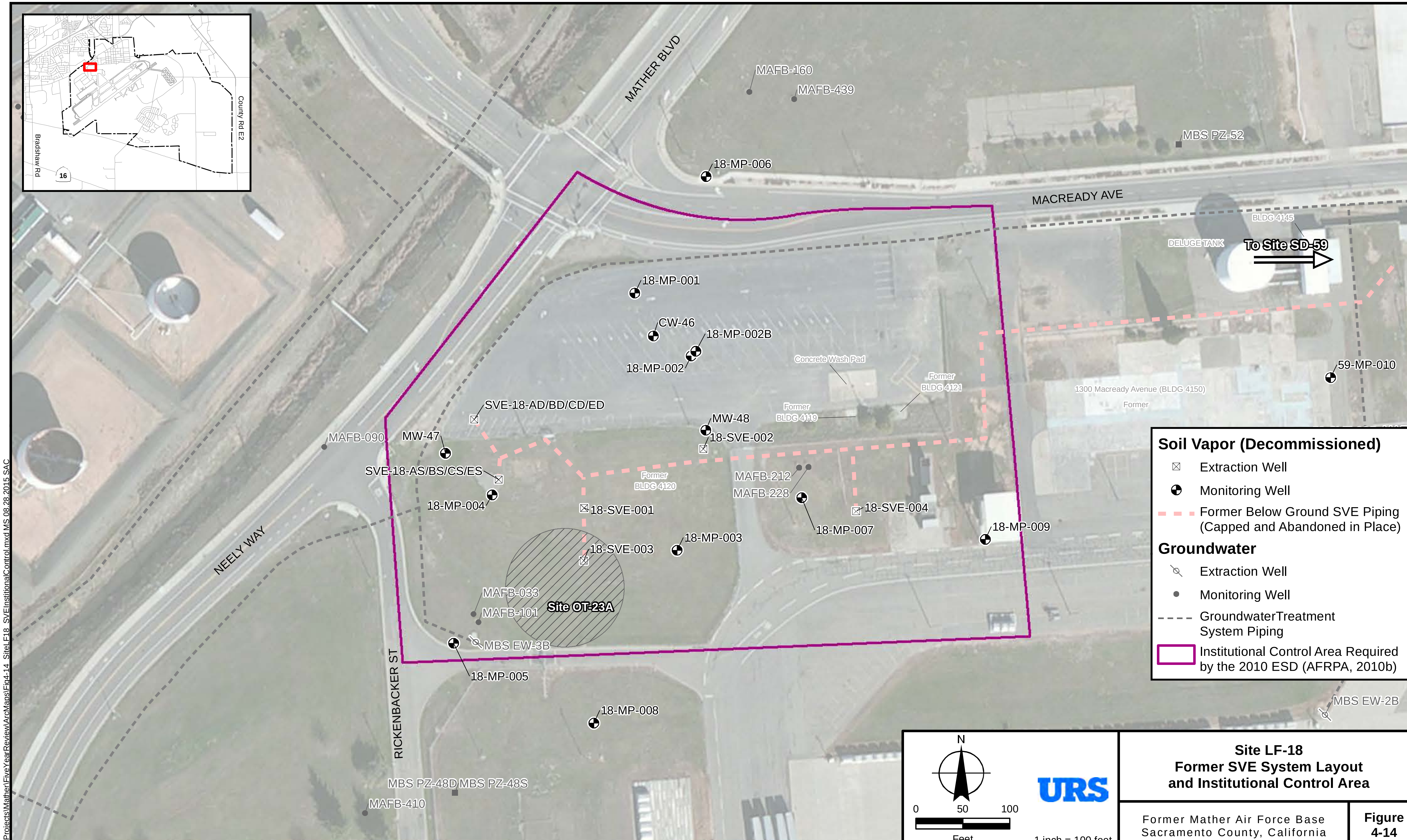
Figure 4-12



Site FT-10C/ST-68
Former SVE/Biovent System Layout and Institutional Control Area

Former Mather Air Force Base
Sacramento County, California

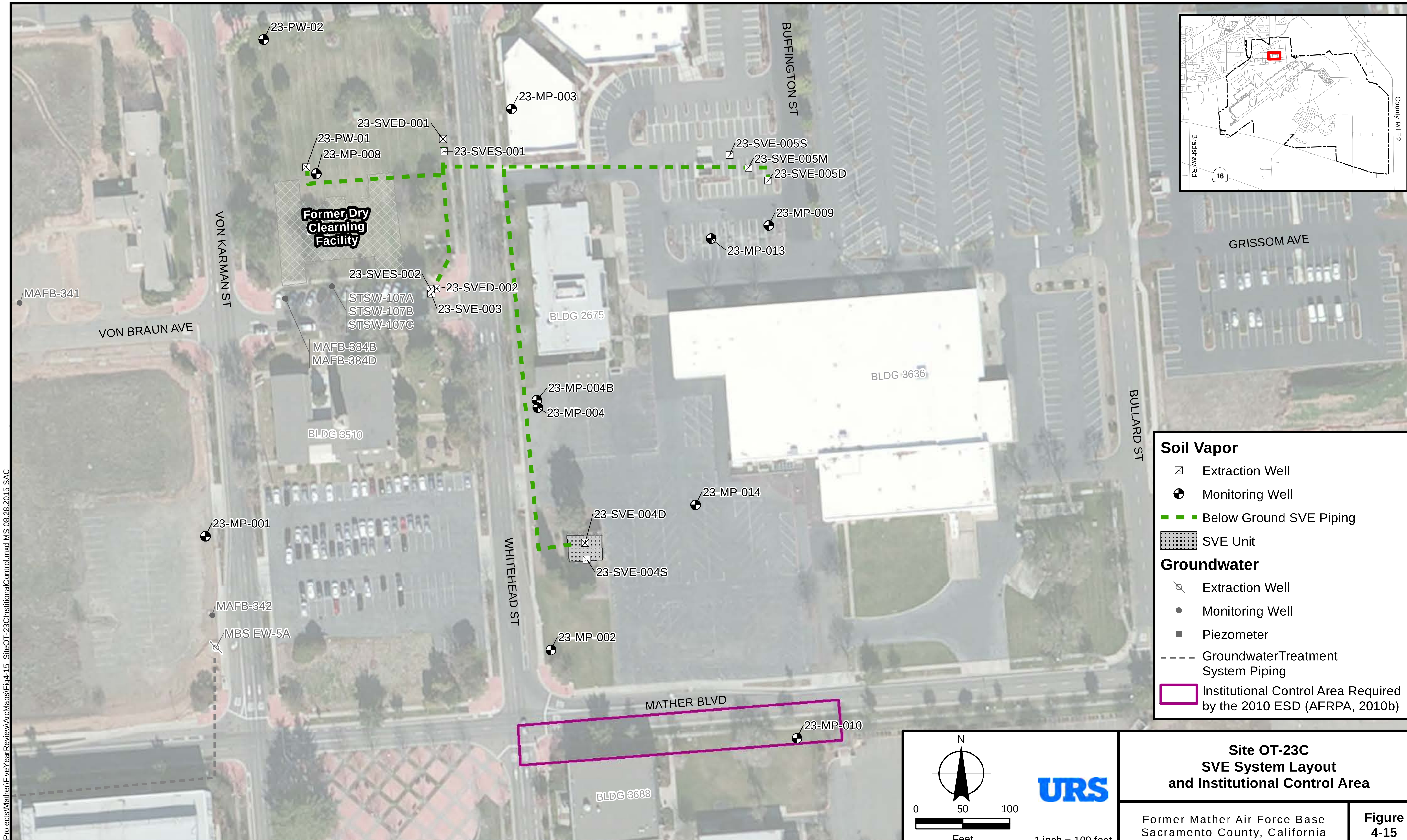
Figure 4-13



Site LF-18
Former SVE System Layout and Institutional Control Area

Former Mather Air Force Base
Sacramento County, California

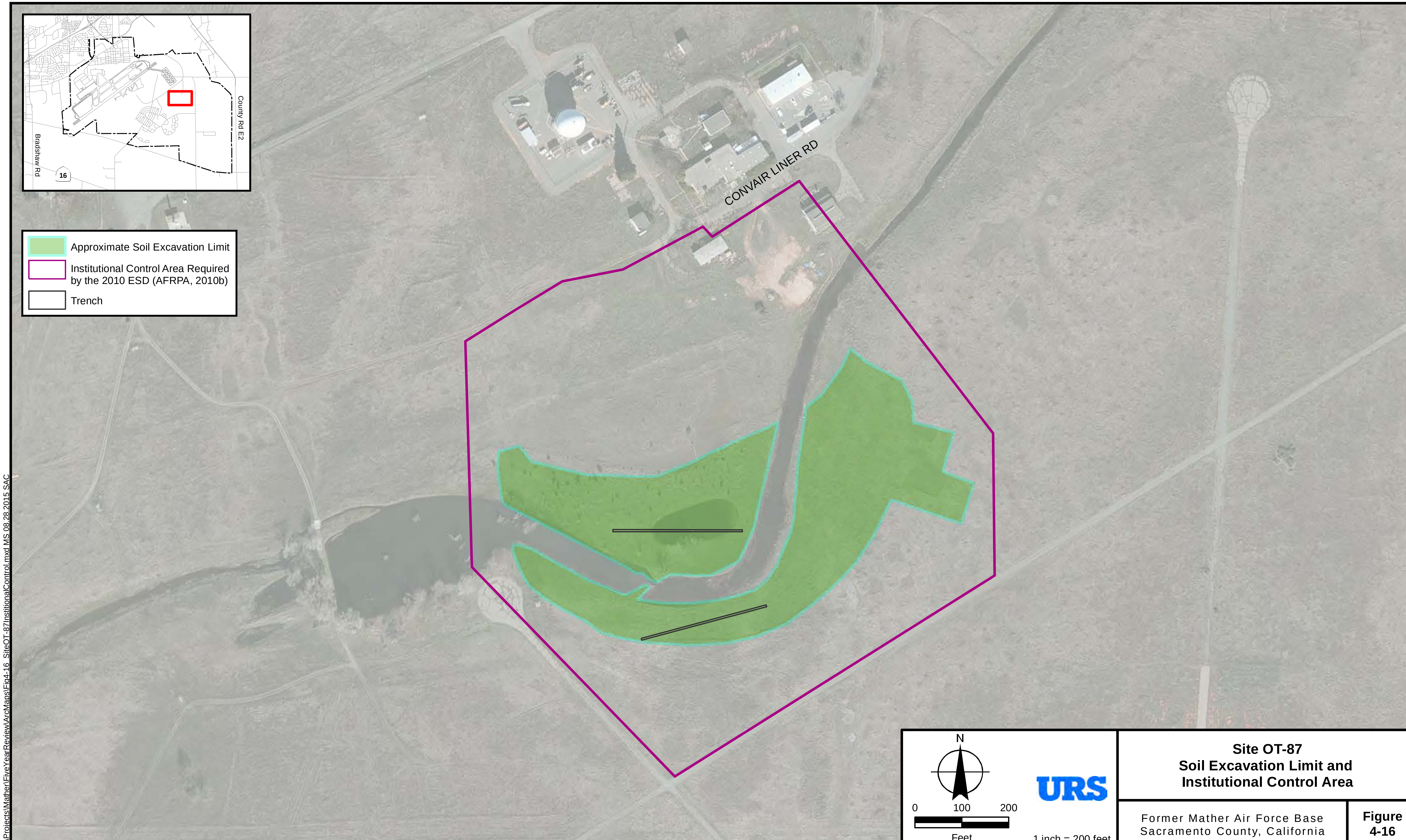
Figure 4-14

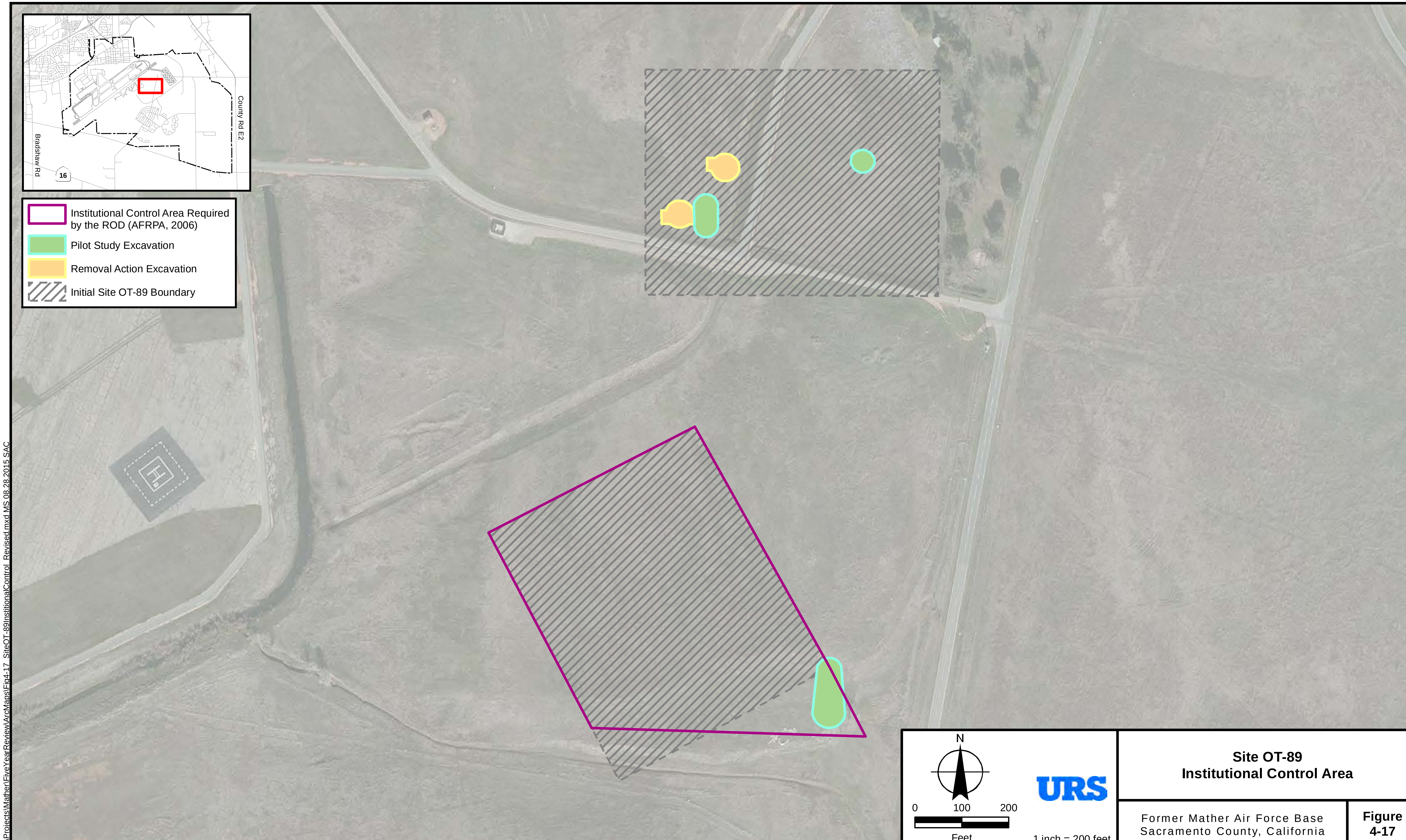


Site OT-23C
SVE System Layout
and Institutional Control Area

Former Mather Air Force Base
Sacramento County, California

Figure 4-15


County Rd E2
Bradshaw Rd
16
Approximate Soil Excavation Limit
Institutional Control Area Required by the 2010 ESD (AFRPA, 2010b)
Trench
CONVAIR LINER RD
N
0
100
200
Feet
1 inch = 200 feet
URS
Site OT-87
Soil Excavation Limit and Institutional Control Area
Former Mather Air Force Base
Sacramento County, California
Figure 4-16
L:\Projects\Mather\FiveYearReview\ArcMaps\Fig4-16_SiteOT-87InstitutionalControl.mxd MS 08.28.2015 SAC


County Rd E2
Bradshaw Rd
16
Institutional Control Area Required by the ROD (AFRPA, 2006)
Pilot Study Excavation
Removal Action Excavation
Initial Site OT-89 Boundary
N
0
100
200
Feet
1 inch = 200 feet
URS
Site OT-89
Institutional Control Area
Former Mather Air Force Base
Sacramento County, California
Figure
4-17
L:\Projects\Mather\FiveYearReview\ArcMaps\Fig4-17_SiteOT-89InstitutionalControl_Revised.mxd MS 08.28.2015 SAC

5.0 PROGRESS SINCE LAST REVIEW

This section describes the progress since the third five-year review, including a description of the protectiveness statements, the status of recommendations and follow-up actions presented in the *Third Five-Year Review Report* (URS, 2010) and the status of any other prior issues.

5.1 Protectiveness Statements from Previous Review

The protectiveness statements for each OU in the *Third Five-Year Review Report* state:

OU 1 – *The remedy for the AC&W OU is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.*

OU 2 – *The remedies for the Groundwater OU currently protect human health and the environment in the short term. However, in order for the remedies to be protective in the long term, ICs must be implemented per the Soil OU and Groundwater OU ESD that is pending authorizing signatures.*

OU 3 – *The remedies for the Soil OU currently protect human health and the environment in the short term. However, in order for the remedies to be protective in the long term, ICs must be implemented per the Soil OU and Groundwater OU ESD that is pending authorizing signatures.*

OU 4 – *The remedies for the Landfill OU are protective of human health and the environment.*

OU 5 – *The remedies for the Basewide OU currently protect human health and the environment in the short term. However, in order for the remedies to be protective in the long term, ICs must be implemented per the Basewide OU ESD that is pending authorizing signatures.*

OU 6 – *The remedy for the Supplemental Basewide OU is protective of human health and the environment.*

Because the “construction complete” milestone was achieved for all OUs at Mather in 2009, a sitewide protectiveness statement was also made:

The remedial actions at the AC&W OU, Landfill OU, and Supplemental Basewide OU are protective. However, because the remedial actions at the Groundwater, Soil, and Basewide OUs are not protective in the long term, the site is not protective of human health and the environment at this time. The remedial actions at these OUs are not protective because ICs are not in place. To ensure protectiveness, ICs need to be implemented per the Soil OU and Groundwater OU ESD and Basewide OU ESD that are pending authorizing signatures.

As described in Section 5.2, the recommendations and follow-up actions presented in the third five-year review were implemented. The technical assessment of the remedial actions in Section 7.0 of this report describe the evaluations conducted and the remedial system modifications made over the past 5 years to address the protectiveness concerns described in the *Third Five-Year Review Report* (URS, 2010). The results of this assessment were used to develop the protectiveness statements presented in Section 9.0 of this fourth five-year review.

5.2 Recommendations and Follow-Up Actions from Third Five-Year Review

5.2.1 OU 1 (AC&W OU)

Recommendation: Continue sampling the Unit D monitoring wells in the eastern portion of the plume area near Boeing extraction well EX-2 to help confirm pumping from the extraction well is not causing migration of TCE into Unit D.

Status: Since 2006, the operation of Boeing extraction well EX-2 (located northeast of the AC&W Plume and screened in Unit D) has induced a downward gradient from Unit C to Unit D near the head of the plume, but sample results from AC&W Unit D wells MAFB-067 and MAFB-068 have not indicated that measurable TCE is migrating downward. TCE was not detected in any samples collected from these wells during the period of this five-year review (2009–2013) (biennial frequency, not sampled in 2014).

Recommendation: Implement plans to shut down extraction wells ACW EW-2 and ACW EW-4, which have TCE concentrations less than ACLs, and monitor for potential rebound while maintaining plume capture. Continued progress of the remedy has been evident during the last 5 years with two extraction wells exhibiting asymptotic levels. One extraction well has also had TCE concentrations less than the ACL since 2Q06, and another well had a TCE concentration less than the ACL in 2Q08. The plume appears to be shrinking in size and trends in monitoring and extraction wells along the center axis of the plume show TCE concentrations have been stable to decreasing over the last 2 years. Data collected from the rebound monitoring may be used to optimize the system and to predict (via modeling) when ACLs may be achieved.

Status: In September 2013, ACW EW-2 was shut down because TCE concentrations had been less than the ACL since 2Q08 and the hydraulic effect of extraction at the well was reducing the effectiveness of extraction at ACW EW-3 and ACW EW-1. The first semiannual sample (4Q13) collected to monitor rebound from ACW EW-2 contained TCE at an estimated concentration of 0.3 μg/L. Semiannual samples will be collected through at least 2Q15.

At ACW EW-4, TCE concentrations were less than the ACL from 2006 through 2009, and the well's pump was turned off in February 2010. No concentration rebound was observed in samples collected from this well between 1Q10 and 2Q12. ACW EW-4 was decommissioned in 2013 (URS, 2013a).

5.2.2 OU 2 (Groundwater OU)

Main Base/SAC Area Plume Recommendation: Continue monitoring and evaluation of sample results from Unit B wells in the area near Happy Lane. The interpreted extent of CCl_4 greater than the MCL in Unit B increased in the area near Happy Lane in 2008. Data evaluation and the Southwest Lobe capture zone analysis (CZA) suggest this area of the plume is captured by extraction well MBS EW-13BuB and the Juvenile Hall supply wells. The sampling results will be used to assess concentration trends and confirm capture of this portion of the plume.

Status: During the period of this five-year review, the CCl_4 concentration at MAFB-173 increased to a historical maximum of 3 μg/L in 2009, but in subsequent samples, the CCl_4 concentration decreased and was slightly greater than the ACL in 2013 (0.6 μg/L). This well is interpreted to be within the capture zone of MBS EW-9B (URS, 2014b). At MAFB-268, the CCl_4 concentration fluctuated during the period of this five-year review and increased from not detected in 2009 to a maximum of 1.1 μg/L in 2011 before decreasing slightly to 1 μg/L in 2013. The portion of the CCl_4 plume beyond the capture zone of MBS EW-9B, including at MAFB-268, is estimated to be captured by MBS EW-13BuB (URS, 2014b).

The extent of the CCl_4 plume in Unit B in the area near Happy Lane has not changed in the last 5 years, and the plume is being captured (see Figure 7-3). COC concentrations will continue to be monitored, and flow rates at MBS EW-9B and MBS EW-13BuB will be optimized, as needed, to ensure the COC plume continues to be captured and does not migrate toward water supply wells.

Main Base/SAC Area Plume Recommendation: Continue monitoring newly installed monitoring wells MAFB-460Bs/Bd and MAFB-461Bs/Bd in the area of OFB-72. Initial sampling of these wells defined the extent of the Southwest Lobe to ACLs. Additional monitoring will aid in confirming this definition of the extent of the Southwest Lobe and the extent of capture by extraction well MBS EW-13BuB. In addition, continue monitoring the off-site private wells in the area of the Southwest Lobe to confirm the wells are not impacted.

Status: As a result of the TCE detections at OFB-72 and concern that plume migration was being negatively influenced by pumping at water supply wells, in 4Q09 MAFB-460Bs/Bd and MAFB-461Bs/Bd were installed downgradient from the Southwest Lobe and upgradient of OFB-72. Both sets of wells were constructed with screened intervals in shallow and deep Unit B. At both MAFB-460Bs and MAFB-460Bd, TCE concentrations have never exceeded the ACL, although at MAFB-460Bs TCE concentrations increased in 2013 and at MAFB-460Bd have generally been increasing since 2012. MAFB-461Bs and MAFB-461Bd are located slightly southwest of the MAFB-460Bs/Bd, closer to several off-base pumping wells (OFB-79, OFB-80, and OFB-85). At MAFB-461Bs and MAFB-461Bd, TCE has been detected at trace to low concentrations (all less than 0.5 μg/L).

These wells help to define the ACL volume, the boundary of which lies between the MWFB-449, MAFB-457, MAFB-458, and MAFB-460 well clusters. These wells also provide vertical definition for TCE, as any concentrations detected in the deeper wells were less than quantitation limits. To help delineate the vertical extent of the TCE plume downgradient from MBS EW-13BuB, a D zone monitoring well (MAFB-462) was installed adjacent to the MAFB-460 location in 2011 (see Figure 7-3). MAFB-462 has been sampled quarterly since its installation, and TCE has never been detected.

A small portion of the Southwest Lobe TCE plume may be beyond the estimated 2013 capture zone for MBS EW-13Bub, which came online in 2008 (see Figure 7-3). The water table in this area is relatively flat, and the precise location of the toe of the plume and the limit of capture is difficult to interpret. TCE concentrations have been decreasing within and near the downgradient edge of the plume since approximately 2010; however, TCE concentrations have been increasing at concentrations less than the ACL at farther downgradient wells since 2012 (MAFB-460Bd) and since mid-2013 (MAFB-460Bs). The capture extent will continue to be assessed with continued monitoring of water levels and TCE concentrations in this area.

OFB-72 and other non-drinking water supply wells (e.g., OFB-79, OFB-80, OFB-81, and OFB-85) near the Southwest Lobe TCE plume have been sampled since 2009. No COCs have been detected at OFB-79, OFB-80, OFB-81, and OFB-85. At OFB-72, TCE concentrations have generally been decreasing since the well was first sampled in 2009 and have never exceeded the MCL (maximum concentration 3.8 μg/L). PCE has also been detected at OFB-72, but concentrations have all been less than 1 μg/L.

Main Base/SAC Area Plume Recommendation: Implement the termination of wellhead treatment maintenance at the Moonbeam Drive supply well. The well has had 6 consecutive monthly samples with concentrations of COCs less than one-half MCLs. A memorandum to Cal Am (AFRPA, 2009c) states that the Air Force plans to terminate the maintenance of the system (6 months from 9 March 2009) in accordance with the Contingency Plan. The well will continue to be sampled as part of the off-base water supply well monitoring program.

Status: In June 2010, the dual-canister GAC system at the Moonbeam Drive well was taken offline, and the carbon was removed from the canisters. The GAC treatment resumed in November 2012 because the CCl_4 concentration had increased to greater than one-half the MCL. (The average concentration of six consecutive samples collected between June and August 2012). CCl_4 concentrations were less than one-half of the MCL (i.e., less than 0.25 µg/L) from October 2012 through May 2014, including six sample results less than the method detection limit. According to the Contingency Plan, these results indicate that wellhead GAC treatment may be discontinued upon providing Cal Am with 6-months' notice. However, GAC treatment cessation had not been proposed as of October 2014, and Cal Am has not operated the well since June 2014.

Site 7 Plume Recommendation: Continue monitoring and evaluate results relative to the detailed CZA of the Site 7 Plume conducted in 2009. The 2009 CZA incorporated data not available during the earlier capture analysis, which used data through 2007. The results of future monitoring may be used to evaluate future system performance, demonstrate capture of the plume, and show progress of the remedy toward achieving objectives.

Status: As reported in the *Annual and Fourth Quarter 2013 Groundwater Monitoring Report* (URS, 2014b), the two Site 7 extraction wells (7-EW-1 and 7-EW-2) operated at a combined average flow rate of approximately 42 gpm during 2013 and removed approximately 2.8 pounds of VOCs from groundwater. Generally decreasing to stable concentration trends in the extraction wells and monitoring wells show the effectiveness of the groundwater extraction, and the plumes are estimated to be captured (URS, 2014b). Progress toward achieving the RAO of attaining ACLs was also made during the period of this five-year review. In 2013, only TCE and 1,2-dichloroethane (DCA) were detected at concentrations greater than their respective ACLs, whereas in the past PCE (most recently in 2010) and cis-1,2-DCE (most recently in 2011) had been detected at concentrations greater than their ACLs.

Northeast Plume Recommendation: Continue to monitor and evaluate concentration trends at monitoring wells MAFB-132, MAFB-133, and MAFB-136. ACLs are currently predicted to be achieved by approximately 2025 at MAFB-132, which is assumed to require the longest time to achieve ACLs in the Northeast Plume. It is too early to determine whether the recent concentration decreases at MAFB-136 indicate a consistent trend. Predictions of time to achieve ACLs should be updated periodically (e.g., as part of each five-year review) to incorporate future monitoring results.

Status: Historical and recent data trends, current groundwater levels, and the hydrogeologic conceptual model indicate the COC ACL volume of the Northeast Plume is isolated to a few wells in close proximity to Sites LF-03 and LF-04 and is not expected to expand laterally. During the period of this five-year review, COC concentrations have been stable or decreasing at the plume edges, excluding the deep well MAFB-398C at Site LF-03; however, they have been generally increasing in the core of the Site LF-04 plume at MAFB-132 since 2009. Detections of cis-1,2-DCE and PCE exceeding the ACLs at Unit C well MAFB-398C indicate that chemicals have migrated to greater depths in Unit C. Because of the increasing concentrations at MAFB-132 and MAFB-398C, an updated prediction of when ACLs may be achieved cannot be made at this time. The concentration trends at these wells are discussed further in Section 7.3.3.

5.2.3 OU 3 (Soil OU)

Site ST-37/ST-39/SS-54 Recommendation. Evaluate alternative remediation approaches (e.g., excavation of shallow soils) or enhancements/modifications (e.g., fracturing or thermal enhancement technologies) to the SVE remedy that are capable of expediting cleanup of residual contamination adsorbed to low-permeability soil.

Status: Bioventing was implemented at Site ST-37/ST-39/SS-54 in late 2010 because the only remaining COCs are petroleum hydrocarbon-related. In December 2013, the BV system was shut down for respiration testing, and in 2014, site closure of the vadose zone will be pursued.

Site SD-57 Recommendation. As previously recommended in SVE semiannual reports, conduct vadose zone modeling at Site SD-57 to determine whether the residual contaminant concentrations in the deep vadose zone just above the water table will result in sufficient mass flux to groundwater to result in aqueous concentrations that exceed ACLs. If contaminant concentrations will impact groundwater, conduct a cost-benefit analysis to assess the need for additional deep SVE wells versus allowing concentrations to persist and be remediated by the Main Base/SAC Area Plume groundwater treatment system.

Status: The SVE system at Site SD-57 was shut down for rebound testing at the end of July 2013, and vadose zone modeling indicated that residual TCE in soil vapor would not significantly impact groundwater or extend groundwater remediation time. A draft closure report was issued on 30 April 2014 documenting that no further treatment of the vadose zone was necessary at Site SD-57 (URS, 2014a). However, additional confirmation soil vapor samples collected from the vapor wells in August 2014 prompted the postponement of the closure report and resumption of SVE operations in September 2014.

5.2.4 Institutional Controls

Recommendation: Ensure that the ICs established in the RODs, ESDs, and the Landfill OU Memorandum of Post-ROD Changes, are monitored on an annual basis, as required, and establish an ICs checklist and monitoring program. In addition, following signature on the Soil OU and Groundwater OU ESD and Basewide OU ESD, annual IC monitoring will be required at the sites noted in those documents.

Status: During the period of this five-year review, IC inspections were conducted at the Landfill OU, AC&W OU, and Supplemental Basewide Site OT-89 in 2010 and covered the period September 2006 through August 2010, where applicable (AFRPA, 2010c). IC inspections were conducted at all sites with ICs requirements in 2011 (URS, 2012b), 2012 (URS, 2013b), and 2013/2014 (AFCEC, 2014), to ensure that ICs are maintained and enforced. An inspection checklist was created for each site and used during the annual inspections to note whether any deficiencies or inconsistent land uses were observed.

5.3 Issues Raised During Completion of the Third Five-Year Review

During finalization of the *Third Five-Year Review Report* (URS, 2010), EPA in their concurrence letter (see letter in URS, 2010) and DTSC and CVWB in their comments on the draft final report (see Appendix C in URS, 2010), expressed a similar concern about data gaps and uncertainties in the groundwater monitoring well network for Area 1 of the Main Base/SAC Area Plume, as defined in the 2007 Capture Zone Analysis Report (MWH, 2007a), Southwest Lobe of the Main Base/SAC Area Plume, and the Site 7 Plume. EPA also noted in their concurrence letter that the Air Force should submit an annual ICs report to the regulatory agencies for review. These concerns were addressed by the Air Force and are summarized here with status updates.

Concern: PCE and CCl_4 concentrations in the vicinity of Unit D monitoring well MAFB-181 are approximately eight times their respective ACLs. There are no nearby monitoring wells screened in deeper portions of Unit D that can be used to monitor vertical migration and determine if capture of the ACL volume is being achieved in this area.

Status: In October and November 2011, two new groundwater monitoring wells (MAFB-463D and MAFB-463Dd) were installed downgradient from MAFB-181 and the PCE hot spot at MAFB-435 to address this concern (see Figure 7-4). MAFB-463D is screened at a depth slightly deeper than MAFB-181 but similar to MAFB-332, which is downgradient from MAFB-463D. MAFB-463Dd was installed in the same borehole as MAFB-463D but screened at a depth deeper than MAFB-435. The PCE concentration at MAFB-463D increased to greater than the ACL in 2012, resulting in the extension of the interpreted downgradient extent of the PCE plume. The plume interpretation based on 2013 data was extended farther downgradient because of the increase in PCE concentration at MAFB-332, which previously had a PCE concentration greater than the ACL in 2007. At MAFB-463, CCl_4 was detected at a concentration greater than the ACL in one 2012 sample but decreased to less than the ACL in 2013, and at MAFB-332, CCl_4 has fluctuated above and below the ACL but was greater than the ACL in the most recent sample collected in 2013. However, the vertical extent of the PCE and CCl_4 plumes is defined because PCE and CCl_4 concentrations at MAFB-463Dd have never exceeded their ACLs. The migration of the PCE and CCl_4 plumes in the downgradient direction likely is the result of the operation of MBS EW-6D, as well as the operation of the Moonbeam Drive (OFB-04) and Juvenile Hall production wells (OFB-51 and OFB-52), all of which are capturing the plumes. At MAFB-181, which is the well noted by the regulatory agencies in 2010, PCE and CCl_4 concentrations generally decreased from 2008 through 2013, and the well is within the capture zone of MBS EW-5D.

Concern: The Southwest Lobe of the Main Base/SAC Area Plume has migrated approximately 1,500 to 2,000 feet beyond the estimated area of capture provided by extraction well MBS EW-13BuB. The existing monitoring network indicates the plume is located primarily in Unit B as it moves off of Mather; however, it may be pulled downward into Unit D by off-site water supply wells screened in Unit D or deeper water-bearing zones. TCE has been detected in off-site industrial supply well OFB-72 at approximately 4 µg/L, and the Air Force has been unable to determine the depth interval from which this well extracts groundwater. Furthermore, there are several other supply wells in the vicinity of OFB-72, and the Air Force has been unable to obtain reliable information on their screen depths and utilization (average pumping rates).

Status: To help delineate the vertical extent of the TCE plume downgradient from MBS EW-13BuB, a Unit D monitoring well (MAFB-462) was installed adjacent to the MAFB-460 location in October 2011. MAFB-462 was sampled quarterly in 2012 and 2013, and TCE was not detected. As discussed in Section 5.2.2, a small portion of the Southwest Lobe TCE plume may be beyond the estimated 2013 capture zone for MBS EW-13Bub (see Figure 7-3), and TCE concentrations have been increasing at downgradient wells MAFB-460Bs (since mid-2013) and MAFB-460Bd (since 2012), albeit at concentrations less than the ACL. TCE concentrations are decreasing within and near the downgradient margin of the plume, and the extent of the TCE plume greater than the aquifer cleanup level decreased from 2008 through 2013. At MAFB-457Bs, which is within the toe of the TCE plume, the TCE concentration decreased in 2012 and 2013 to near the ACL at a concentration of 6.4 µg/L in 2013. The capture extent will continue to be assessed with continued monitoring of water levels and TCE concentrations in this area.

Eighteen additional off-base, privately owned wells (OFB-69 through OFB-86) have been sampled for VOCs since 2Q09 or 2Q10 to supplement the existing monitoring data from within and far downgradient from the Southwest Lobe TCE plume. With the exception of OFB-72, no COCs have been detected in samples collected from these wells. OFB-72, the private well closest to the downgradient edge of the Southwest Lobe, is owned by Teichert and operates intermittently, filling a holding tank with water that is used to fill water trucks for dust control in the aggregate mine areas. OFB-72 has been sampled quarterly since 2Q09 and TCE concentrations decreased with some fluctuations from a maximum of 3.8 µg/L in 2010 to 1.1 µg/L in 3Q14.

In 2009, the Air Force reviewed all available state well records for wells in the vicinity of the Southwest Lobe. The Air Force requested information from the owners of the wells closest to the Southwest Lobe, but the only information available for OFB-72 was the depth of 238 feet bgs tagged during pump repair in

2008 or 2009. In 2010, Teichert estimated that OFB-72 pumps at 300 gpm, 10 hours per day, 5 days per week and OFB-85 pumps at 1,000 gpm, 16 hours per day, 5 days per week. However, based on field observations, these wells are not pumping as long or as frequently as reported by the well owner; therefore, these values are not considered to be accurate year-round.

Concern: Installation of a monitoring well at the southern toe of the Site 7 plume is needed to verify plume extent and capture. Capture in this area of the plume may be incomplete, and the reduced pumping capacity in 7-EW-1, due to well damage, has further diminished the capability of this well to capture the toe of plume in the future. Actions should be implemented to increase pumping at 7-EW-1. If additional rehabilitation is not effective, extraction well 7-EW-1 may need to be replaced or augmented with a new extraction well to provide adequate capture of the Site 7 plume.

Status: 7-EW-1 was redeveloped in 2012, and the flow was increased from approximately 11 to 21 gpm. As of March 2014, the flow rate at 7-EW-1 was approximately 23.5 gpm. The well was redeveloped again in April 2014, and the flow rate was increased to approximately 29 gpm. Although the pumping rate at 7-EW-1 has decreased since the well initially began operating, 7-EW-1 continues to remove mass from the toe of the plume. Since 7-EW-1 was returned to service in late 2006, TCE concentrations at MAFB-372B, downgradient from 7-EW-1 (see Figure 7-5), have decreased from greater than the ACL to less than the ACL in 2013. In 2008, two groundwater monitoring wells were installed near the toe of the plume. MAFB-445 was installed in Unit B approximately 750 feet east of 7-EW-1 to help define the eastern edge of the plume; no COCs have been detected exceeding their ACLs in the seven samples collected from that well. MAFB-448 was installed southeast of MAFB-372B in an attempt to bound the downgradient extent of the plume. However, the 2008 baseline sample for MAFB-448 contained TCE at a concentration exceeding the ACL. The TCE concentration at MAFB-448 increased to a maximum of 9.0 µg/L in 4Q09 but decreased to a concentration less than the ACL in 2012 and remained less than the ACL in 2013.

To address the regulatory agencies' concern noted above, MAFB-464 was installed downgradient of the southern extent of the Site 7 plume in 2011 (see Figure 7-5). COCs have not been detected at concentrations greater than their ACLs at MAFB-464, and the maximum TCE concentration reported was 1.1 µg/L in 4Q12. Throughout 2013, TCE was reported at trace concentrations at MAFB-464. TCE concentrations at MAFB-371C, downgradient of 7-EW-1, have shown an increasing trend since 2006, and in 2Q14 the concentration was 5.0 µg/L. However, this concentration is not greater than the ACL and capture zones developed using groundwater potentiometric surface data in 2013 show that capture by 7-EW-1 extends past the toe of the plume and beyond MAFB-371C (URS, 2014b). The capture extent will continue to be assessed with continued monitoring of water levels and TCE concentrations in this area.

Concern: Annual IC inspection reports should be submitted to the regulatory agencies for review.

Status: As discussed in Section 5.2.4, IC inspections were conducted throughout the period of this five-year review and reported in *Report of Compliance with Institutional Controls at the Former Mather Air Force Base, September 2006 through August 2010* (AFRPA, 2010c); *2011 Annual Report of Compliance with Institutional Controls, Former Mather Air Force Base, August 2010 through January 2012* (URS, 2012b); *2012 Annual Report of Compliance with Institutional Controls at the Former Mather Air Force Base* (URS, 2013b); and 2013 Annual Report of Compliance with Institutional Controls at the Former Mather Air Force Base (AFCEC, 2014).

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6.0 FIVE-YEAR REVIEW PROCESS

This section describes the activities performed during the Mather five-year review process, including identification of the five-year review team, notification of the local community, review of relevant documents and data, inspection of current site conditions, and performance of interviews to assist in determining site status.

6.1 Administrative Components

The Mather fourth five-year review team includes the following RPMs:

Douglas Self	AFCEC
John Lucey	EPA (Region 9)
Franklin Mark	DTSC
Marcus Pierce	CVWB

William Hughes (Cherokee Nation Technology Solutions), who has provided technical oversight for the Mather IRP for many years and prepared the first and second five-year reviews for Mather, is also a key member of the five-year review team. Note that the list of RPMs does not include all those who have contributed to this program over the last 5 years. Each RPM has support staff that has made contributions to project management or implementation. As of 2014, other contributors to the Mather IRP include:

Paul Bernheisel	AFCEC Field Engineer
Kenneth Smarkel	Noblis, Inc., Technical Support to AFCEC
Linda Geissinger	AFCEC Public Affairs Manager
Viola Cooper	EPA Community Involvement Coordinator
Nathan Schumacher	DTSC Public Participation Specialist
Gino Yekta	CalRecycle Remedial Project Manager
Angela Thompson	SMAQMD Representative
Rick Balazs	Sacramento County Department of Economic Development
Philip Benedetto	Sacramento County Airport System
Paul Graff	URS Group, Inc., Performance Based Remediation Contractor Program Manager
Brian Sytsma	Sytsma Group, Public Affairs Support to AFCEC

Members of the review team were notified of the initiation of the fourth five-year review for Mather at the December 2013 Base Realignment and Closure Cleanup Team meeting and briefed on the schedule at the March 2014 technical working group meeting. Table 6-1 presents the schedule for this fourth five-year review report.

Table 6-1. Fourth Five-Year Review Schedule

	Draft			Draft Final			
Document Title	**Submission Date**	**Review Period**	**Comments Due Date**	**Submission Date**	**Comment Response Confirmation Review Period**	**Comment Confirmation Due Date**	**Final Date, if Comments Not Received**
Fourth Five-Year Review Report	23 June 2014	60 days	22 August 2014	1 May 2015	30 days	1 June 2015	1 June 2015

Note: Additional comments were received from DTSC and the California Department of Fish and Wildlife in June 2015 and discussed at the 10 June 2015 Base Realignment and Closure Cleanup Team meeting. The Air Force responses to these comments are in Appendix C of this final document.

6.2 Community Involvement and Notification

The Mather IRP has maintained an active community involvement program since the 1980s. Information on the Community Relations Program and community participation can be found in the *Mather Community Relations Plan* (MWH, 2004), which was updated in 2014 (Sytsma Group, 2014). Additional community information is available online at http://www.afcec.af.mil/brac/mather/. Key components of the Community Relations Program include:

- Providing general information updates to the community through the periodic distribution of fact sheets and newsletters to a community mailing list of interested citizens, regulatory agencies, media, government officials, local businesses, civic and community groups. Mailing list subscribers receive newsletters, fact sheets, environmental updates, flyers, and other documents.

- Holding open houses, posterboard sessions, and site tours that offer the public opportunities to meet government representatives, ask questions one-on-one, express concerns, and receive information about the Mather cleanup program.

- Notifying the community of upcoming general public meetings, program milestones, the release of documents, and public comment periods through public notices (paid newspaper advertisements) placed in local newspapers, as required by EPA guidance.

- Holding public meetings or briefings (e.g., at Rancho Cordova City Council meetings and Cordova Community Council meetings) to provide information about the IRP and opportunities for community involvement and to present milestone documents and solicit public review and comment, as required.

From 1994 to 2011, the Restoration Advisory Board (RAB) served to provide a greater opportunity for members of the public to learn about Mather's environmental cleanup program, to review and comment on environmental plans and reports, and to provide input to the Air Force and regulatory agencies on cleanup decisions. The RAB consisted of several community members and was co-chaired by a community member and a representative from the Air Force. The RAB held regular meetings open to the public, and meeting minutes were distributed to a mailing list of interested people. In 2011, the RAB was adjourned in accordance with 32 CFR Part 202 and the procedures outlined in *Management Guidance for the Defense Environmental Restoration Program* (Office of the Deputy Under Secretary of Defense [Installations and Environment], 2001) due to dwindling community participation and completion of all major cleanup decision documents (AFRPA, 2011d). Input from the primary recipient of Mather property (Sacramento County) was also crucial in deciding to adjourn (AFRPA, 2011d). RAB adjournment does not affect the continuing cleanup at Mather because the Air Force is required by law to complete the last remaining cleanup activities at the former base.

In accordance with EPA guidance, AFCEC will notify the community of Mather's fourth five-year review at the beginning and conclusion of the process (EPA, 2001). A public notice was published on 8 April 2014 in the *Sacramento Bee*. The notice provided an overview of the fourth five-year review process, outlined the five-year review schedule, and noted how and where the public will be able to view the final report.

As part of the fourth five-year review process and also to update the Community Relations Plan, AFCEC solicited regional stakeholders for feedback regarding ongoing environmental restoration activities at Mather. Stakeholders asked to participate in interviews included a cross-section of community members. Section 6.5 includes a summary of the interviews, and Appendix B contains the interview records.

A public notice will be published in the *Sacramento Bee* to notify the community of the completion of the review process and finalization of the fourth five-year review. This notice will briefly summarize the review, note how and where the public can view the report, and list points of contact for community members who would like to obtain more information or ask questions about the results of the fourth five-year review.

This fourth five-year review report for Mather will be available for viewing by the public in the Mather Administrative Record, located at 3411 Olson Street, McClellan, California 95652, or online at http://afcec.publicadmin-record.us.af.mil/Search.aspx.

6.3 Document and Data Review

The five-year review process included a review of documents relevant to the Mather IRP Program, including RODs for each OU, subsequent ESDs, and previous five-year reviews. Documents relevant to the implementation and performance of the groundwater, vadose zone (i.e., soil), landfill, and ICs remedies were also reviewed in the preparation of this five-year review. These documents include quarterly, semiannual, and/or annual monitoring reports, as well as various closure, remedial action, and CZA reports. Documents relevant to the performance of the various treatment systems were reviewed to ensure the systems are operating in accordance with their O&M manuals. In addition, RI/FS and risk assessment documents were reviewed as needed. Documents that were consulted during the preparation of this report are cited throughout this document and included in the reference list in Section 11.0 of this report.

In general, data collected from January 2009 through 30 September 2014 were reviewed for the technical assessment in this fourth five-year review, including those data presented and evaluated in the monthly, quarterly, semiannual, and/or annual progress monitoring reports, which are cited throughout this document, where appropriate. More recent data and analyses (through November 2014) are also included for some sites. For groundwater remedy performance assessments, hydraulic and analytical data reviewed include groundwater level changes, gradients, flow directions, capture zones, groundwater quality data, including trends, mass removal data, and effluent compliance data. For SVE/BV remedy performance assessments, data reviewed include analytical concentration data from both field measurements and laboratory analysis of vapor samples, extraction and emission rate data, mass removal data, compliance data, and operational data (e.g., uptime, electrical usage, and destruction rate efficiency). For the landfill remedy performance assessments, data reviewed include gas monitoring data, compliance data, site inspection reports, and the results from the topographic surveys conducted every 5 years.

6.4 Site Inspections

The annual IC site inspections conducted on 10 March 2014 served as the site inspections for this five-year review, as the sites requiring IC inspection are included in this five-year review. The results of the inspections are reported in the *2013 Annual Report of Compliance with Institutional Controls at the Former Mather Air Force Base* (AFCEC, 2014). In addition, AFCEC staff, located at McClellan, California, approximately 10 miles from Mather, and AFCEC support staff have maintained familiarity with the physical condition of the sites and remedial systems through approximately weekly inspection visits to Mather. Through these personnel, remedial action contractors that are on site on a daily basis conducting O&M tasks and sampling activities, and periodic regulatory agency visits, the Air Force and regulatory agencies have maintained familiarity with environmental remediation activities and site conditions at Mather.

6.5 Site Interviews

As part of the five-year review process and also to update the Community Relations Plan, a series of interviews were conducted to evaluate opinions and concerns regarding the environmental restoration activities at Mather. The interview process included two components – interviews with community members, and interviews with O&M representatives, including the RPMs and O&M contractor for Mather.

In May and June 2014, 10 community members were interviewed in person, over the phone, or by written questionnaire by AFCEC public affairs support staff. Interviewees included the local Sacramento County Supervisor, the City of Rancho Cordova Vice-Mayor (also a former RAB member), Sacramento County Deputy Director of Economic Development, a Sacramento County Supervising Environmental Specialist, the Mather Airport Manager, a former RAB Community Co-Chair, the Elementary Program Coordinator for Sacramento Splash, the Mather Sports Complex Operations Supervisor, a member of the Sacramento Metropolitan Fire District, and the External Affairs representative for Cal Am.

The Sacramento County Supervisor, Deputy Director of Economic Development, Cal Am representative, Airport Manager, and Rancho Cordova Vice-Mayor expressed knowledge of and satisfaction with the completed and ongoing environmental cleanup efforts at Mather and that the Air Force, regulatory agencies, county, and community have worked well together to accomplish the cleanup and redevelopment of the site. Several interviewees noted that they were pleased with the positive benefits (e.g., jobs, recreation, and habitat preservation) that have resulted from cleanup and redevelopment of the site.

The Sacramento County Supervisor and Rancho Cordova Vice-Mayor indicated that they understand that groundwater cleanup will take many more years but that the Air Force is working towards accomplishing the cleanup goals. The Vice-Mayor noted the general loss of interest in the Mather cleanup by the community and attributed that in part to confidence from the community that the cleanup will be completed. The county Supervisor also noted the community's confidence in the Air Force and regulatory agencies to achieve the cleanup goals and that the Air Force and regulatory agencies work together to resolve issues when they arise. The county Supervisor and Vice-Mayor said that most community members generally are not that interested in the cleanup at Mather unless something important happens or a problem arises. Then, people want to be informed or will ask why they have not been informed.

The Rancho Cordova Vice-Mayor stated that he is aware ICs are in place on former Mather property to restrict land uses or to require permission to dig and understands the need in part for those ICs to protect cleanup systems. The Sacramento County Deputy Director of Economic Development also indicated that he is aware ICs are in place on portions of former Mather property and that the county is complying with those ICs. He said that there are plans to lease, sell, or transfer property where ICs are in place and that there are plans to build new structures.

The Rancho Cordova Vice-Mayor noted his appreciation for being part of the former RAB and being able to share his knowledge about the cleanup activities at Mather with others. The former RAB Community Co-Chair expressed a similar sentiment regarding the RAB as being a place to learn and keep the community informed about the cleanup at Mather. She did note, however, that she has no current knowledge of the cleanup at Mather and that the last newsletter she received in 2012 was not very informative.

Three community members did not feel well-informed about the cleanup program at Mather. The Mather Sports Complex Operations Supervisor noted that she has seen activity going on at Mather but did not know what kind of work was being done. The Fire District member stated that there is really no need for him to be informed, and he assumed there was a cleanup program since Mather is a former Air Force Base. The Elementary Program Coordinator for Splash stated that she had not actively sought out information about the Mather cleanup program. She also noted her concern about preserving two vernal pools where development is being planned, although she did indicate she understands the balance between protection of habitat and land development. It should be noted that the two vernal pools mentioned in the interview are not in areas where Mather environmental cleanup activities are occurring.

The majority of the interviewees were not aware of any current community concerns regarding the cleanup at Mather. The one exception was the Cal Am representative who said there are concerns from customers about contamination in the water. He suggested continuing outreach efforts to explain that the water is being treated and healthy water is being served to the community.

A common comment received from the community representatives was the importance of continuing to distribute information and making information available about the ongoing cleanup actions at Mather, especially to key stakeholders, such as the City Council, Cordova Community Council, and homeowners associations.

The former RAB Community Co-Chair stated that newsletters with more in-depth information about the cleanup activities at Mather should be distributed more frequently and suggested an annual summary be distributed through the mail. Most interviewees indicated their preference for receiving information through email. However, they suggested other methods of communication that other community members may find useful such as: hosting periodic public meetings; providing periodic updates at Cordova City Council meetings, which are televised, documented in the public record, and minutes posted on the city website; posting on the Grapevine Independent website; creating a Mather website (e.g., on Facebook and recruit followers); and leaving information at City Hall. The former RAB Community Co-Chair was the lone interviewee who commented on the current Mather website, which in her opinion is not that useful and of which she thinks most people are unaware.

The interviewees also suggested reaching out to other entities (e.g., Sacramento Metropolitan Fire, Mather Airport, Rancho Cordova Elks Lodge, county parks, local school district, Sacramento Splash, Independence Housing, and Veterans Affairs Hospital) that have a presence at Mather to keep them informed of the cleanup activities at Mather.

For the O&M representatives, all potential interviewees were initially contacted by email to request their participation in the interview process by completing a survey. Of the 11 O&M representatives asked to participate in the interview process, 6 responded and completed surveys by email. Four of the six responders are current or former representatives for AFCEC, and the other two responders are from URS, the Mather O&M program contractor.

In general, the overall impression of the remedial actions selected for Mather's IRP was favorable; the remedies are appropriate and functioning as expected; and where unexpected conditions were encountered, remedies were modified or ICs were added. The time to reach cleanup goals for the groundwater and soil vapor remedies may be of concern. Concern also was expressed regarding the effectiveness of the SVE systems in remediating residual low contaminant concentrations due to moisture in the soil and the soil types (fine-grained) where contaminants remain and the conservative assessment by the regulatory agencies of remedial progress and application of narrative soil cleanup levels. These issues have delayed closure of some of the SVE sites. For groundwater, responders commented that monitoring data generally show decreasing trends with a few areas of increasing trends. The increasing trends do not indicate an unknown source or necessarily a deficiency of the remedial action but may be the result of the soil types (fine-grained) where little dilution may occur as contamination enters less transmissive aquifer materials (e.g., beneath the landfills). The O&M contractor also noted that the systems are functioning well despite the age of the equipment, but that obsolete technology and equipment result in costly repairs and difficulty in obtaining replacement parts. For example, the fiber optic communications scheme that allows the supervisory control and data acquisition system and programmable logic controller to communicate with the extraction wells is obsolete and communication failures occur frequently.

Other unexpected O&M difficulties or costs during the last 5 years noted by the O&M representatives include: (1) vandalism and theft at the AC&W groundwater treatment system that resulted in the system being offline for 3 months and expensive site-wide security upgrades; (2) failure of a solar-powered fan at Site LF-04 that resulted in an exceedance of the methane compliance limit; and (3) re-installation of GAC at the off-base Cal Am Moonbeam Drive water supply well after CCl_4 concentrations reported at the well triggered re-establishment of treatment.

In general, the AFCEC and O&M representatives stated that the treatment systems and monitoring programs are being optimized and are fairly efficient but that adding one or more additional groundwater extraction well in conjunction with shutting off or reducing flow at existing wells may improve efficiency of the groundwater cleanup. An AFCEC representative also noted that the Air Force's optimization goals of shortening cleanup times and reducing lifecycle costs need to be made clearer in future contracts and that those contracts potentially could provide incentive for contractors to reduce their costs while pursuing those goals.

Regarding ICs, AFCEC and O&M representatives noted that the Air Force has complied with monitoring and reporting requirements during the last 5 years but that Sacramento County and the State of California have not yet executed all of the required SLUCs, which would transfer monitoring and reporting responsibility to the property recipient. However, an AFCEC representative noted that there are also many other ways ICs are monitored, reported, or enforced (e.g., county ordinance on groundwater consultation zone, county property zoning, engineering controls [airport/landfill fences], dig alerts, and groundwater, SVE, and landfill annual reports). One AFCEC representative commented that some of the IC boundaries should be adjusted in areas where they are not needed to avoid unnecessarily delaying routine underground work within roadways or public utility easements due to the lengthy regulatory agency notification and approval requirements process.

AFCEC and O&M representatives also commented that perfluorinated compounds are emerging COCs related to fire-training facilities at Air Force bases. A preliminary assessment of perfluorinated compounds is underway at Air Force facilities, and the results will be used to determine whether further CERCLA investigations and remedial actions are necessary.

The responses from the five-year review interviews will be taken into account as AFCEC moves forward with the community involvement program and continues its environmental restoration activities at Mather. Appendix B includes the interview records.

7.0 TECHNICAL ASSESSMENT

The technical assessment for remedial and removal actions at Mather consists of determining whether those actions are, or on completion will be, protective of human health and the environment. To reach a protectiveness determination, EPA guidance recommends that the following three questions be addressed for each action (EPA, 2001):

- Question A – Is the remedy functioning as intended by the decision documents?
- Question B – Are the exposure assumptions, toxicity data, cleanup standards, and RAOs used at the time of the remedy selection still valid?
- Question C – Has any other information come to light that could call into question the protectiveness of the remedy?

Answers to these three questions help ensure that all relevant issues are considered when determining the protectiveness of the remedy.

Questions A and C are addressed on a site-by-site basis in Sections 7.2 through 7.7. Question B is discussed in Section 7.1. The technical assessment for each site focuses on the performance of the remedial actions during the period of this fourth five-year review.

7.1 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

Question B is discussed here because the same discussion applies to the RAO for most of the remedial actions (i.e., protection of groundwater quality). Discussing Question B here avoids repeating much of the same text in the assessment for each site.

Each of the components in Question B is addressed below and includes a discussion of changes during the last 5 years and a general assessment. This assessment is referred to as appropriate in the site-specific sections (Sections 7.2 through 7.7) that follow.

7.1.1 Are the exposure assumptions used at the time of the remedy still valid?

The exposure assumptions used during the original risk assessments for Mather were based on current and anticipated future land use at each site. The exposure assumptions used at all sites were for residential use. An additional set of exposure assumptions were evaluated for some sites where industrial or recreational use was anticipated. Sites OT-87, OT-89, and the landfills (Sites LF-03, LF-04, and WP-07) have remedies that are incompatible with unrestricted land use, and therefore, have ICs as a part of their remedies.

Inhalation exposure to volatile compounds that have migrated from the subsurface into the indoor air of overlying structures (the “vapor intrusion pathway”) is a now well-recognized exposure pathway that was not well understood, nor evaluated, during development of the original risk assessments. Therefore, ICs to prevent potential unacceptable exposure to VOCs in indoor air have been added to the remedies for Sites FT-10C/ST-68 and LF-18, and as necessary for Sites ST-37/ST-39/SS-54, SD-57, OT-23C, and SD-59. The authorizing ESDs state that these ICs will be imposed only if necessary (AFRPA, 2010a; 2010b), although they are included in the current deeds. If the site soil vapor data demonstrate that all of the soil vapor concentrations at a given site are compatible with unrestricted land use, these ICs will no longer be required by the remedy. Sites FT-10C/ST-68 and LF-18 were closed with indoor air ICs deemed necessary.

For groundwater, an evaluation of the potential risk from the vapor intrusion pathway was presented in the *Third Five-Year Review Report* (URS, 2010), and even though toxicity factors for some chemicals have changed since the last five-year review, the conclusions of the evaluation are still relevant because there are no completed, new, or previously unconsidered, exposure pathways relevant to the Groundwater OU or AC&W Plume. As part of the third five-year review, cumulative risk or hazard estimates were evaluated for both residential and commercial land use scenarios for: compliance with de minimus levels (i.e., site cancer risk less than 1E-06 and site noncancer hazard index less than 1.0), within EPA's "risk management range" for Superfund (1E-04 to1E-06), or exceedance of the risk management range (greater than 1E-04), as described below.

Main Base/SAC Area Plume. The generic and semi-site-specific risk estimates calculated in 2009 for the third five-year review for the on- and off-site portions of the Main Base/SAC Area Plume were less than or within the risk management range for commercial and residential land use, except for the on-site portion of the Main Base/SAC Area Plume, which had a generic screening risk estimate for residential land use that was slightly greater than 1E-04 (URS, 2010). However, the generic screening estimate does not consider site conditions (e.g., depth to groundwater and subsurface soil type) as the semi-site-specific assessment does. In addition, the concentration data from the two water table wells (MAFB-420 and MAFB-439) evaluated for the last five-year review represented worst-case conditions at specific locations in the Main Base/SAC Area Plume, which is not representative of the risk across the entire site. Concentrations are still greatest at those two wells, but the concentrations have decreased (e.g., TCE at MAFB-420 was 270 μg/L in 2009 and 55 μg/L in 2013). There are no residential-type buildings overlying these portions of the plume, and residential-type development in these areas is unlikely given the current use as an air field. Therefore, there is no currently completed on-site residential exposure pathway.

Relative to potential commercial exposure, MAFB-439 is currently in an open field, and the hot spot at MAFB-420 underlies an open field, a taxiway, and hangars. These facilities do not fit the typical building conditions for commercial indoor air exposure, so it is likely that this risk is less than estimated, and COC concentrations are decreasing. Also, the water table elevation has been decreasing and is at approximately 95 feet bgs. As noted in EPA guidance, vapor concentrations generally decrease with increasing distance from a subsurface vapor source, and eventually at some distance the concentrations become negligible (EPA, 2002). Available information suggests that 100 feet laterally and vertically is generally conservative (EPA, 2002).

Vapor intrusion is not considered an issue off site from the former Mather AFB, as there are no completed exposure pathways and none are likely. As of 2013, no COCs are present at concentrations greater than ACLs at off-site water table wells.

Site 7 Plume. The generic and semi-site-specific vapor intrusion risk screening analyses conducted in 2009 for the third five-year review used data from MAFB-041 and MAFB-446, which had the highest COC concentrations in the Site 7 Plume (URS, 2010). Concentrations are still greatest at those two wells, but the concentrations have decreased (e.g., TCE at MAFB-446 was 57 μg/L in 2009 and 21 μg/L in 2013). Both the commercial and residential generic screening and semi-site-specific screening estimates were within the risk management range of 1E-06 to 1E-04. However, there are currently no buildings over the footprint of the Site 7 Plume. Almost the entire Site 7 Plume is off site under an area previously excavated for gravel mining, and there are no known future plans for buildings in this area. An area near the plume has been reclaimed as a seasonal wetland/marsh, so it is unlikely that buildings will be placed near the wetlands and plume. Consequently, there is no completed commercial or residential vapor intrusion exposure pathway for the Site 7 Plume.

Northeast Plume. There are no buildings over the footprint of the Northeast Plume; therefore, there are no completed exposure pathways and none are likely because the ICs prohibit construction of any structures within 1,000 feet of LF-03 or LF-04 on former Mather property without obtaining regulatory agency approval of plans to mitigate any potential hazardous gas exposure.

AC&W Plume. Vapor intrusion is not considered an issue for the AC&W Plume because of the depth to water. In 2013, the depth to groundwater was approximately 135 feet bgs, and groundwater levels are stable to declining. Considering this depth to groundwater (i.e., in excess of 100 feet), there is no completed pathway (EPA, 2002). A hardpan layer is present in shallow soils over much of the AC&W area that would further impede vapor migration from the groundwater plume and completion of the vapor intrusion pathway. Consequently, the remaining TCE concentrations in the AC&W Plume do not pose an unacceptable risk via the vapor intrusion pathway to any industrial or residential receptors.

No other exposure assumptions have changed or otherwise become invalid since the risk assessments and remedy selections.

7.1.2 Are the toxicity data used at the time of the remedy still valid?

With the exception of soil sites that contained lead, the basis for cleanup at all of the non-landfill sites covered in this review is protection of groundwater quality. The ongoing soil cleanup by SVE and/or BV is based on protection of groundwater quality by removing sources in the soil that would otherwise prolong groundwater cleanup or render groundwater cleanup more expensive.

EPA policy states that it will not reopen remedy selection decisions contained in RODs unless a new or modified requirement calls into question the protectiveness of the selected remedy. As noted in Section 7.1.3, none of the ACLs established for groundwater contaminants have been revised since the RODs were signed. ACLs for groundwater COCs were established as the contaminant-specific California or federal MCL, if an MCL existed. If an MCL did not exist, some other health-based guideline, such as an EPA-suggested no-adverse-response level (SNARL) or a toxicity value determined per EPA's hierarchy guidance was used to establish an ACL. Since approval of the Soil OU and Groundwater OU ROD, federal and California MCLs for total xylenes have been promulgated; total xylenes are a COC for the Main Base/SAC Area Plume. However, the ACL (17 μg/L) is still more stringent than either the federal (10,000 μg/L) or state (1,750 μg/L) MCLs. Consequently, a review of ARARs indicates that no new standards have been promulgated or proposed since the RODs were signed that would call into question the protectiveness of the remedy for groundwater. However, this review evaluates the ACLs with respect to the latest risk estimates supported by EPA and the State of California.

The numbers recommended for use in risk assessments have changed for many of the COCs at Mather since the risk assessments were completed and remedial actions were selected. The relationships between contaminant concentrations and health effects are quantified in cancer slope factors and hazard indices that represent estimates based on the available toxicological data. These factors are combined with exposure assumptions to provide estimates of the risk of health effects that would result from the assumed exposure to a given concentration of a contaminant (or group of contaminants).

Therefore, the groundwater ACLs were re-evaluated with the latest toxicity data. The primary source for toxicity data for a five-year review is the EPA Integrated Risk Information System (IRIS) database (EPA, 2014a). During the period covered by this fourth five-year review, four COCs received agency-approved toxicological reviews and revisions to toxicity values: CCl_4, cis-1,2-DCE, PCE, and TCE. Toxicity value revisions have gone in both directions; for example, TCE is now considered to have increased toxicity relative to the previous assessment, while PCE is considered by EPA to have reduced toxicity relative to the previous assessment. As mathematical components of equations used to derive risk estimates or cleanup goals, any change in a value affects any derived values. A revision to TCE toxicity values has resulted in a revision to EPA's carcinogen-based and noncancer-based site screening values (regional screening levels [RSLs], formerly preliminary remediation goals [PRGs]) to concentrations less than the MCL. At present, however, while these toxicity value changes are becoming integrated within the current discipline of risk assessment, they have not yet resulted in changes to enforceable standards (i.e., MCLs); therefore, the ACLs for Mather will not be revised. Groundwater ACLs for Mather remain protective of human health because the values of the ACLs are generally equal to, or less than, a corresponding MCL and they do not exceed the NCP's risk management range.

Table 7-1 compares the ACLs for COCs in the AC&W OU and Soil OU and Groundwater OU RODs to EPA RSLs (EPA, 2014b) and Cal/EPA Office of Environmental Health Hazard Assessment (OEHHA) public health goals (PHGs) (OEHHA, 2014). The RSLs and PHGs include concentrations in drinking water that correspond to a de minimus (inconsequential) cancer risk of 1E-06 (equivalent to the "per million" notation on Table 7-1), assuming a 30-year exposure time and life span of 70 years. Table 7-1 also lists the incremental lifetime cancer risk (ILCR) estimated for each ACL using both the RSL and PHG risk assumptions. To evaluate protectiveness of the ACLs, the associated ILCR estimates are compared to the risk management range defined in the NCP (40 CFR 300). The risk management range in 40 CFR 300.430(e)(2)(i)(A)(*2*) is between 1E-06 to 1E-04, which is equivalent to 1 per million to 100 per million. All of the risk estimates for the ACLs are within or less than this range.

Table 7-1. Groundwater Aquifer Cleanup Levels Compared to EPA Regional Screening Levels and California Public Health Goals

Contaminant of Concern	Aquifer Cleanup Level (μg/L)	Current MCL (μg/L)	RSL (μg/L)	ILCR Based on RSL (per million)	PHG (μg/L)	ILCR Based on PHG (per million)
Benzene	1	1	0.45	2.2	0.15	6.7
Carbon tetrachloride	0.5	0.5	0.45	1.1	0.1	5.0
Chloromethane	3	NA	190	0.02	NA	NC
1,1-Dichloroethene	6	6	280	0.02	10	0.6
1,2-Dichloroethane	0.5	0.5	0.17	2.9	0.4	1.3
cis-1,2-Dichloroethene	6	6	36	0.17	100	0.06
1,2-Dichloropropane	5	5	0.44	11	0.5	10.0
1,4-Dichlorobenzene	5	5	0.48	10	6	0.8
Tetrachloroethene	5	5	11[a]	0.45[a]	0.06	83
Trichloroethene	5	5	0.49	10	1.7	2.9
Xylenes, total	17	1,750	190	0.09	1,800	0.01
Vinyl chloride	0.5	0.5	0.019	26	0.05	10

[a] DTSC Office of Human and Ecological Risk (2014) recommends use of the 2004 EPA Region 9 PRG of 0.10 μg/L, which results in an ILCR of 50 per million.

DTSC = Department of Toxic Substances Control
EPA = United States Environmental Protection Agency
ILCR = incremental lifetime cancer risk
MCL = maximum contaminant level
NA = not available
NC = not calculated
PHG = public health goal
PRG = preliminary remediation goal
RSL = regional screening level
μg/L = micrograms per liter

The other consideration when evaluating the risk associated with the ACLs is that the plume consists of various mixtures of the COCs. When all of the ACLs are met, there may still be mixtures of COCs at concentrations at or less than the ACLs. The health risk of some or all of the contaminants in these mixtures may be cumulative, or in other words, some or all of the remaining contaminants may contribute in an additive way to the cancer risk. At the time of the third five-year review, a sum of the estimated risks associated with all the groundwater ACLs was approximately 112 in 1 million (URS, 2010), which was greater than the risk management range. The cumulative risk estimate for this five-year review is approximately 64 in 1 million, which is within the risk management range. The cumulative risk using the PHG risk assumptions is 120 in 1 million, of which PCE contributes approximately 69 percent. However, it is not known that the risks are actually cumulative, and this assessment presents the worst-case scenario by assuming that the risk from all the contaminants is additive. This evaluation also assumes that concentrations in a hypothetical water sample consist of all of the COCs at ACL concentrations and that this is the sole drinking water source for the assumed exposure. This assumption is overly conservative, as some of the COCs are rarely detected in groundwater at Mather and not all of the COCs listed in Table 7-1 are COCs for each of the four groundwater plumes. For example, in the Site 7 Plume, vinyl chloride was detected in only one well in 2013. If vinyl chloride is included in the cumulative risk estimate, the sum of the risk estimates is 51 in 1 million and 105 in 1 million, using the RSL and PHG risk assumptions, respectively. However, if vinyl chloride is excluded from the cumulative risk estimate, the sum of the risk estimates is 25 in 1 million and 95 in 1 million, using the RSL and PHG risk assumptions, respectively. These estimates are within the risk management range. For the other three plumes (AC&W, MBS/SAC Area, and Northeast), the cumulative risk estimates for the COCs for those plumes are all less than 100 in 1 million regardless of whether the RSL or PHG risk assumptions are used. See Table 3-1 for a list of COCs by plume.

The DTSC recommends use of the 2004 EPA Region 9 PRG of 0.10 μg/L for PCE as the RSL (DTSC Office of Human and Ecological Risk, 2014). This PRG is based upon the California OEHHA 1991 toxicity value for TCE, and is approximately 23 times more stringent than the updated EPA IRIS (2012) value. Using the EPA hierarchy, the DOD and Air Force use the updated IRIS (2012) value. For completeness, comparisons to the DTSC recommended value are included here. Using 0.10 μg/L for PCE would increase the cumulative risk estimate for this five-year review to 114 in 1 million. For the Site 7 Plume example, using the DTSC-recommended RSL for PCE would increase the cumulative risk to 101 in 1 million if vinyl chloride were included, and to 75 in 1 million if vinyl chloride were excluded. For the other three plumes, the cumulative risk estimate would still be less than 100 in 1 million if the DTSC-recommended RSL were used.

The cleanup levels for lead in soil at Sites FT-10C/ST-68, OT-87, and OT-89 are 800 mg/kg (15 mg/L soluble), 700 mg/kg, and 192 mg/kg, respectively. These concentrations are health-protective under commercial/industrial or recreational land use scenarios but not under the unrestricted use scenario. Consequently, ICs are in place as a part of the remedies for Sites OT-87 and OT-89. However, at Site FT-10C/ST-68, it was anticipated that the excavation effort would also meet the unlimited use and unrestricted exposure threshold of concern of 151 mg/kg that was established through site-specific determinations using DTSC's LEADSPREAD model and documented in the 2008 ESD for Site FT-10C/ST-68 (AFRPA, 2008b). Following excavation, the maximum lead concentration remaining in soil following excavation at Site FT-10C/ST-68 was 127 mg/kg with an average concentration of 44 mg/kg and a median concentration of 19 mg/kg. These concentrations are less than 151 mg/kg, and all soluble lead concentrations were less than 15 mg/L (MWH, 2009b). Therefore, ICs related to lead contamination are not required at Site FT-10C/ST-68. In addition, it should be noted that 151 mg/kg is less than EPA's 400 mg/kg residential RSL for lead.

In 2009, OEHHA developed revised industrial and residential California human health screening levels (CHHSLs) for lead. The residential CHHSL for lead in soil is 80 mg/kg, and the industrial CHHSL for lead in soil is 320 mg/kg (OEHHA, 2009). The residential CHHSL is less than the 151 mg/kg threshold of concern compatible with unrestricted use established in the 2008 ESD for Site FT-10C/ST-68 (AFRPA, 2008b); however, it is the Air Force's position that CHHSLs are not promulgated standards, are not enforceable, and are not ARARs for Site FT-10C/ST-68. The 151 mg/kg unrestricted use level established in the 2008 ESD is health-protective, and ICs are not needed at Site FT-10C/ST-68. Consequently, no new standards have been promulgated or proposed since remedy selection that would call into question the protectiveness of the remedy for soil at Site FT-10C/ST-68.

For completeness, a 95th upper confidence limit (95th UCL) of the mean was calculated for lead concentrations remaining at the three sites (Appendix D). For Site FT-10C/ST-68, results indicate that the 95th UCL is 101.4 mg/kg. Inputting this result into the updated DTSC LEADSPREAD model yields a 90th percentile estimate of increase in blood lead level in a child of 1.3 μg/dl. For Site OT-87, the 95^{th} UCL from the area covered by the ICs is 256.7 mg/kg, and the 90th percentile increase in blood lead level for a child is 3.3 μg/dl. For Site OT-87, outside the area covered by the ICs, the 95th UCL concentration is 41.1 mg/kg, and the 90th percentile estimate of increase in blood lead level in a child is 0.5 μg/dl. For Site OT-89, inside the IC area, there were too few sample points from which to calculate a 95th UCL, but over most of this area, the lead-bearing horizon is buried and not readily available for exposure. The maximum concentration detected in samples from this area is 16.3 mg/kg. For the areas outside the IC area, to the north, the 95th UCL is 57.27 mg/kg, and the 90th percentile estimate of increase in blood lead level in a child is 0.7 μg/dl; to the south, the 95th UCL is 75.4 mg/kg and the increase in blood lead level in a child is 0.9 μg/dl.

7.1.3 Are the cleanup levels used at the time of the remedy still valid?

Under CERCLA, a remedy is required to protect human health and the environment. To achieve this requirement, remedial actions must meet ARARs. The ARARs can be defined as requirements in promulgated state and federal environmental laws as they relate to on-site remedial actions. Where ARARs are insufficient or not available, other requirements to be considered (TBCs) may be identified. The TBCs are non-promulgated advisories, criteria, guidance, or proposed standards issued by federal and state agencies (40 CFR 300.400(g)(3)). A TBC is not enforceable nor is it legally binding and does not have the same status as an ARAR, unless it is selected in a ROD or other decision document as a cleanup level or to achieve an acceptable level of risk.

In the five-year review process, requirements promulgated or modified after the ROD is signed must be addressed if they are necessary to ensure that the remedy is protective of human health and the environment (40 CFR 300.430(f)(ii)(B)(1)).

Chemical-Specific ARARs. The AC&W Plume and Groundwater OU remedial goals (ACLs) were initially established through available environmental or health-based standards. These standards were presented as ARARs in the RODs and include state or federal MCLs for most groundwater contaminants; secondary MCLs for petroleum hydrocarbons; and the SNARL for chloromethane. MCLs are legally enforceable standards that are agency-derived after formal review of health risk and technological and economic considerations. RSLs and PHGs are based solely on health risk assessment.

EPA's IRIS program (EPA, 2014a) is a primary determinant of, and repository for, toxicity values used to generate risk-based guidelines. As discussed in Section 7.1.2, during the period covered by this fourth five-year review, four COCs received agency-approved toxicological reviews and revisions to toxicity values: CCl_4, cis-1,2-DCE, PCE, and TCE. The revision to the TCE toxicity values occurred in September

2011; soon after, EPA issued revised RSLs[1] for tap water, resulting in changes in screening values from 2.0 to 0.44 µg/L (based on carcinogenic effects) and subsequently revised in 2014 to 0.49 µg/L, and from 21 to 2.6 µg/L (based on noncancer effects) and subsequently revised in 2014 to 2.8 µg/L. RSLs are strictly "risk-based" values, in contrast to MCL values, which are established to be health-protective for short-term and long-term exposures, and in consideration of economic impacts and the technological feasibility of achieving treatment goals. For purposes of chemical-specific ARARs for this five-year review, all the toxicity value changes, including the RSLs, remain as TBCs that have not been adopted as part of the remedy, as none of the changes have yet been incorporated into enforceable standards.

The protectiveness of the AC&W Plume and Soil OU and Groundwater OU ROD ACLs can be evaluated through a comparison of the ACLs with current MCLs and other guidelines (Table 7-1). Groundwater ACLs remain protective of human health because the values of the ACLs are generally equal to, or less than, a corresponding MCL and they do not exceed the NCP's risk management range.

For soils and/or soil vapor, numeric cleanup levels established for some of the SVE sites, including Sites WP-07/FT-11, ST-37/ST-39/SS-54, SD-59, and FT-10C/ST-68, were deleted by the Soil OU and Basewide OU ESDs (AFRPA, 2010a; 2010b). Rather than use artificially low numeric cleanup levels, the ESDs replace the numeric soil cleanup levels and apply the existing narrative soil cleanup levels established in the Soil OU and Basewide OU RODs (AFBCA, 1996a; 1998c) and reiterated in the ESDs (AFRPA, 2010a; 2010b).

As discussed in Section 7.1.2, the cleanup levels for lead in soil at Site FT-10C/ST-68, Site OT-87, and Site OT-89 are still valid and protective of human health and the environment.

Action- and Location-Specific ARARs. Action-specific ARARs are usually technology- or activity-based requirements, while location-specific ARARs are restrictions placed on the chemical contaminant or the remedial activities based on the site's geographic or ecological features. Relative to landfills, the ARARs from CCR Titles 14 and 23 have been revised since they were selected as ARARs when the Landfill OU and Soil OU and Groundwater OU RODs were prepared. These regulations have been combined, revised, and recodified into Title 27 of the CCR. Only the ARARs addressing the post-closure status of the landfills remain applicable or relevant and appropriate. Section 7.4 summarizes these ARARs and discusses them in more detail.

The action-specific and location-specific ARARs presented in the RODs and ESDs were re-evaluated for protectiveness. No changes to the action-specific ARARs or location-specific ARARs were identified that affect the protectiveness of the remedies.

There are no new action- or location-specific requirements that have a bearing on the protectiveness of the selected remedies. The action-specific and location-specific ARARs continue to support the protectiveness of the remedies.

7.1.4 Are the remedial action objectives used at the time of the remedy still valid?

None of the RAOs used at the time of remedy selection have changed and all are still valid. The RAOs for each site are listed in Section 4.0, including the additional RAOs that were established for the sites where

[1] RSLs are used for site "screening" and are developed using risk assessment guidance from the EPA Superfund program. They are generic, long-term health-protective concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data and are calculated without site-specific information. RSLs are guidance and, therefore, are TBCs that have not been adopted as part of the remedy.

ICs were later added to the remedies. As discussed in Sections 7.2 through 7.7, the various remedies have made progress toward meeting their RAOs.

7.2 OU 1 (AC&W OU)

7.2.1 AC&W Plume

7.2.1.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the AC&W OU ROD (AFBCA, 1993), as modified by two ESDs (AFBCA, 1997a; AFRPA, 2008a).

Remedy Performance. In September 1998, AFBCA issued an OPS report for the AC&W Plume remedial action (AFBCA, 1998d), which received EPA concurrence in November 1998 (EPA, 1998). The OPS report documents that the remedial action is operating as designed and is successfully remediating groundwater contamination at the site. Figure 7-1 shows the entire area of the plume greater than the ACL lies within the area of contoured drawdown created by the extraction wells and indicates lateral hydraulic capture of the plume in 2013. Groundwater samples collected from Unit D wells have not contained detectable concentrations of TCE, indicating vertical capture of the plume has been successful.

A visual comparison of the extent of the TCE plume in 4Q08 and 4Q13 shows a decrease in plume area from 32 acres in 2008 to 18 acres in 2013 (Figure 7-1). This 44 percent reduction in plume area indicates capture and continued progress of the remedial action. However, during the period of this five-year review, concentrations have increased within the upgradient portion of the plume at extraction wells ACW AT-1, ACW AT-2, and ACW EW-1. Monitoring wells ACW PZ-10C, MAFB-196, and MAFB-453 also had new maximum concentrations in 2013.

Increasing concentrations within the upgradient portion of the plume may indicate a continuing contribution of TCE to the aquifer from either the vadose zone or a source in the saturated zone. The second five-year review suggested addressing a potential residual source by adding carbon substrate to promote biodegradation of TCE. However, the residual source area, if present, needed to be delineated (i.e., vadose zone and/or saturated zone), and a conceptual model of its mass and flux to the groundwater needed to be refined before the cost and duration of cleanup by adding carbon substrate or another alternative could be compared to the groundwater extraction and treatment system cost. Consequently, several groundwater piezometers were installed in suspected source areas and near selected extraction wells. To determine whether there was TCE in the vadose zone, an SVE pilot study was conducted in 2002. The groundwater piezometers did not identify any residual source areas within the saturated zone, and the SVE pilot study indicated there was no TCE source within the vadose zone (MWH, 2003b).

In the downgradient portion of the plume, concentration trends have been generally stable or decreasing since approximately 2002 and, as of 4Q13, only MAFB-194 and ACW EW-6R had TCE concentrations greater than the ACL (Figure 7-1).

At ACW EW-4, TCE concentrations were less than the ACL from 2006 through 2009. Extraction at this location was terminated in 2010, and the well was decommissioned in 2013 (along with ACW EW-5, which had been shut down since 2000). ACW EW-2 was shut down in 2013. TCE concentrations have been less than the ACL at this location since 2Q08 and the hydraulic effect of extraction at the well was diminishing effective extraction at ACW EW-3 and ACW EW-1. The first semiannual sample (4Q13) collected to monitor rebound at this location contained TCE at an estimated concentration of 0.3 µg/L. ACW EW-6R was also shut down in August 2013 because concentrations had been less than the ACL since 2011. However, the first rebound sample collected in 4Q13 contained TCE at a concentration exceeding the ACL (estimated at 8.7 µg/L). Based on this result, and because ACW EW-6R is the farthest downgradient extraction well, extraction was resumed at this well in December 2013. In July 2014, ACW EW-3 was shut down because TCE concentrations had been less than the ACL since 2009, TCE concentrations in nearby monitoring wells were less than the ACL, and shutdown of the well would not allow contamination greater than the ACL to escape capture.

Boeing extraction well EX-2 is northeast of the AC&W Plume (Figure 7-1) and is screened in Unit D, the horizon beneath that containing the AC&W Plume. The well began operating in 2006 to remove perchlorate not associated with Mather or the AC&W Plume; the AC&W TCE plume is present in the overlying Unit C. Upward vertical gradients induced by pumping for the AC&W remedial action have helped to limit or prevent vertical transport of TCE into Unit D. TCE was not detected during the period of this five-year review at Unit D monitoring wells MAFB-067, MAFB-068, and MAFB-069 in the upgradient portion of the AC&W Plume area. There is no evidence of downward vertical migration of the TCE plume from Unit C to Unit D.

System Compliance. During the period of this five-year review, samples were collected from the AC&W treatment system influent quarterly. From 2009 through 2Q10, samples were collected from the effluent biweekly and through 2013, monthly. From 2009 through 2013, the effluent samples met the total VOC discharge treatment standards (total monthly median of 0.5 µg/L and daily maximum of 1.0 µg/L). Samples were also collected quarterly at the Mather Lake receiving water location (R-2). From 2009 through 2013, low concentrations (less than 1.0 µg/L) of chloroform and chloromethane were occasionally detected in these samples. However, those VOCs have not been identified as COCs for the AC&W Plume, and they were not detected in the effluent samples collected in conjunction with the Mather Lake samples. In addition, Mather Lake is inspected monthly for any unusual conditions (algae blooms, turbidity, foams, etc.) resulting from the discharge of the treated groundwater. No adverse conditions have been observed. The AC&W groundwater treatment system was in compliance with the air emissions ARARs from 2009 through 2013 (based on the substantive requirements of rules promulgated by SMAQMD). Discharge monitoring results are presented in the annual groundwater monitoring reports (MWH, 2010j; URS, 2011b; 2012d; 2013e; 2014b).

Institutional Controls. ICs are in place and effective. Inspections were conducted to ensure that ICs are maintained and enforced in 2010 covering the period November 2008 through August 2010 (AFRPA, 2010c); 2012, covering the period September 2010 through January 2012 (URS, 2012b); 2012, covering all of 2012 (2013b); and 2013, covering all of 2013 (AFCEC, in preparation). Through 2013, no deficiencies or inconsistent land uses were observed during the ICs inspections, with one exception. On 29 December 2012, the fence surrounding the AC&W groundwater treatment system was cut by vandals, and the remedial system was extensively damaged, resulting in the system being offline until 15 March 2013. Subsequently, security upgrades were implemented at the AC&W groundwater treatment system, as well as at the other remedial systems site wide.

As of October 2014, three of the four parcels associated with Site WP-12 ICs had been transferred from Air Force ownership, and the deed restriction language in the 2008 ESD (AFRPA, 2008a) was included in the deeds. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deeds. In January 2014, a SLUC was executed for one parcel (G-1a); therefore, the new property owner is required to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. If the transferee fails to provide an annual compliance report to the state in accordance with the executed SLUC, then under CERCLA and the NCP, the Air Force is responsible for monitoring and reporting on the ICs in order to be in compliance with the terms of the 2008 ESD (AFRPA, 2008a) and to be protective of human health and the environment. One other parcel was assigned to, and accepted by, the DOI in January 2013 but had not yet been transferred to Sacramento County as of June 2014. For the other two parcels, no SLUC is planned.

Progress Toward Meeting RAOs. The results of performance monitoring of the AC&W remedial action for the last 5 years indicate continued success in removing TCE from groundwater and with meeting the discharge standards for the treated groundwater. Progress has been made toward meeting the TCE ACL, although concentrations have been increasing in the upgradient portion of the plume during the last 5 years. If the increasing trends continue, additional monitoring wells may be necessary to define the ACL plume. However, in 2014, TCE concentrations decreased at the three monitoring wells mentioned above, including to less than the ACL at ACW PZ-10C and MAFB-196. An additional extraction well may be needed to supplement the current extraction well network or potentially replace one of the existing extraction wells, such as ACW AT-1, which can only operate at approximately 6 gpm due to both the nature of the aquifer and decreasing water levels in the area. Nevertheless, the AC&W OU remedy remains protective of human health and the environment because ICs to prevent human exposure to groundwater with concentrations of TCE exceeding the ACL are in place and effective.

The calculated total TCE mass removed from February 1995 through December 2013 was approximately 479 pounds with 1.6 billion gallons of groundwater removed (URS, 2014b). The influent concentration to the air stripping system was relatively stable, at approximately 5 to 7 μg/L from 2009 through 2012, but increased by the end of 2013 to approximately 11 μg/L. By comparison, the initial influent concentration in 1995 was 130 μg/L. The increase in 2013 is likely due to the shutdown of extraction at ACW EW-2 and ACW EW-6R (ACW EW-6R only shut down for approximately 3.5 months), resulting in less dilution of the contaminated groundwater extracted from the other operating wells.

ICs have been implemented for the AC&W Plume and are monitored annually to meet the RAOs of (1) preventing human exposure to groundwater with concentrations of TCE exceeding the ACL of 5 μg/L, (2) protecting the integrity of the remedial system, including the associated monitoring system, and (3) protecting necessary access to the remedial system, including the associated monitoring system. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections, with the exception of the property damage and vandalism that occurred at the groundwater treatment plant in December 2012.

7.2.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but the MCL used to establish the TCE ACL has not changed since the ACL was established in the AC&W OU ROD; and the changes in toxicity data do not result in the ACL exceeding the NCP risk management range. Therefore, the TCE ACL is still considered protective of human health and the environment.

7.2.1.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.3 OU 2 (Groundwater OU)

7.3.1 Main Base/SAC Area Plume

7.3.1.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Soil OU and Groundwater OU ROD (AFBCA, 1996a), as modified by the 2010 Soil OU and GW OU ESD (AFRPA, 2010a).

Remedy Performance. In March 2011, AFBCA issued an OPS report for the Main Base/SAC Area Plume remedial action (AFRPA, 2011a), which received concurrence from EPA in July 2011 (EPA, 2011b). The OPS report documents that the remedial action is operating as designed and is successfully remediating groundwater contamination at the site.

Unit A/Water Table. During the time period of this five-year review, the extent of the COC plume in Unit A/Water Table decreased slightly as a result of continued removal of COCs by the groundwater extraction system. Figure 7-2 shows a comparison of the plume boundaries in 4Q08 and 4Q13. The water table plume area has decreased from 194 acres in 2008 to 183 acres in 2013 (a decrease of 6 percent).

Downgradient from the Site OT-23C source area in the upgradient portion of the plume none of the operating water table extraction wells in the area (i.e., MBS EW-12AB, EW-7ABu, and EW-39ABuB) had COCs reported at concentrations greater than ACLs in 4Q13 (URS, 2014b). MBS EW-7ABu was shut down in 2012, but restarted in 2013 to maintain capture in the area around MAFB-405, which is currently the only well in the upgradient portion of the plume with a COC (TCE) exceeding its ACL. The plume at MAFB-405 is captured (Figure 7-2).

The water table portion of the plume in and downgradient from the Site SD-57 source area was relatively stable during the period of this five-year review. Groundwater with relatively high concentrations of COCs continues to be extracted by MBS EW-1ABu, EW-2ABu, EW-4ABu, EW-5ABu, and EW-2AR (Figure 7-2). One well in this area, MBS EW-6ABu, has not had COC concentrations greater than ACLs since 2007 and may not be necessary for capture near the Site SD-57 source area. The well was inoperable in 2008 due to mechanical, pressure, and injection capacity issues but was restored to service in 2009 (MWH, 2010j).

The extent of the downgradient portion of the plume increased due to the concentrations reported at MAFB-452Bu, which was installed in 2009, but the plume remains defined by concentrations less than ACLs at MAFB-258 and MAFB-172. The southern portion of this plume and the larger upgradient plume are only partially captured by MBS EW-1Bu and MBS EW-4Bu (Figure 7-2); however, downgradient extraction well MBS EW-13BuB (Figure 7-3) likely provides capture, and the detected concentrations of COCs in the southern portion of these lobes are relatively low. Therefore, any uncaptured COC mass in this portion of the lobe is likely to be minimal.

In 2008, a TCE plume was present at MAFB-121 (west of the Mather property boundary) but in 2013, a plume is not depicted because the well went dry in 2009 and did not recover. However, TCE concentrations at this well were decreasing, and the last sample collected at the well in 2Q08 contained TCE at a concentration of 6 µg/L, slightly greater than the ACL of 5 µg/L.

In 2013, 1,1-DCE was not detected exceeding the ACL in any samples collected from water table wells. In 2012, the 1,1-DCE plume was defined by one well (MAFB-418).

Unit B. During the period of this five-year review, the extent of the COC plume in Unit B decreased as a result of continued removal of COCs by the groundwater extraction system. Figure 7-3 shows a comparison of the plume boundaries in 4Q08 and 4Q13. The plume area has decreased from 1,030 acres in 2008 to 723 acres in 2013 (a decrease of 30 percent). The plume area reduction has mostly occurred in the off-base portion of the plume, with smaller changes at the edges of the on-base portion of the plume (Figure 7-3). Figure 7-3 also shows that extraction well MBS EW-13BuB, installed and brought online in April 2008 to control and remove mass from the Southwest Lobe, captures almost the entire lobe of the plume and that the plume extent has decreased since 4Q08. The decrease in plume area in Unit B indicates capture and continued progress of the remedial action.

In addition, samples from several Unit B extraction wells along Old Placerville Road (i.e., situated along the northern portion of the plume) did not contain any COCs at concentrations greater than ACLs between at least 2010 and 2013 (Figure 7-3). In the *Annual and Fourth Quarter 2013 Mather Groundwater Monitoring Report* (URS, 2014b), termination of extraction at MBS EW-1B, MBS EW-3B, MBS EW-4B, and MBS EW-5B was recommended, and on 28 March 2014, these wells were shut down. Starting in 2Q14, monitoring (water levels and quality) at these wells will continue for at least four semi-annual periods to confirm that the operation of extraction wells MBS EW-3B and MBS EW-7B will maintain capture of contaminated groundwater in Unit B.

In response to the TCE detections reported at MAFB-457Bs and MAFB-458Bd after their installation in 2008, 16 off-base private water supply wells were sampled for VOCs analysis by the Air Force for the first time in 2Q09. These wells are to the southwest and regionally downgradient of the Southwest Lobe. Only one well, OFB-72, had a detectable concentration of TCE (3.8 μg/L). As a result of the TCE detected in samples from OFB-72 and concern that plume migration was being significantly influenced by pumping supply wells, two dual-completion monitoring wells (MAFB-460Bs/Bd and MAFB-461Bs/Bd) were installed in late 2009 in the area of OFB-72 to better define the extent of the Southwest Lobe and to collect potentiometric data in the vicinity of the leading edge of the plume (MWH, 2010j). TCE concentrations from samples collected at MAFB-460Bs/Bd and MAFB-461Bs/Bd have been less than the ACL, although they generally increased at MAFB-460Bd during 2012 and 2013 and at MAFB-460Bs since mid-2013. These wells help to define the ACL volume, the boundary of which lies between MAFB-457/MAFB-458 and MAFB-460. MAFB-460Bs/Bd and MAFB-461Bs/Bd also provide vertical definition for TCE, as any concentrations detected in the deeper wells were less than the ACL. To help delineate the vertical extent of the TCE plume downgradient from MBS EW-13BuB, a D zone monitoring well (MAFB-462) was installed adjacent to the MAFB-460 location in 2011. MAFB-462 has been sampled quarterly since its installation, and TCE has never been detected.

Unit D. During the period of this five-year review, the extent of the plume in Unit D decreased as a result of continued removal of COCs by the groundwater extraction system. Figure 7-4 shows a comparison of the COC plume boundaries in 4Q08 and 4Q13. The plume area has decreased from 386 acres in 2008 to 286 acres in 2013 (a decrease of 26 percent). The decrease in plume area in Unit D indicates capture and continued progress of the remedial action.

The portion of the plume on Mather has remained relatively stable between 4Q08 and 4Q13. The only notable change in the plume during this period occurred between 2012 and 2013, when the PCE concentration at MAFB-358D, located at the head of the plume, became less than the ACL, reducing the upgradient extent of the plume.

West of the former base boundary, monitoring well MAFB-318 had increasing concentrations of PCE and CCl_4 from 2004 until 2011 and 2012, respectively, when the concentrations of both COCs decreased. For PCE, the concentration approached the ACL in 2011 but decreased in the subsequent two samples. For CCl_4, the concentration was greater than the hot-spot concentration (exceeding 10 times ACL) in 2011 and 2012 but decreased to less than the hot spot concentration in 2013. MAFB-318 is southwest of extraction well MBS EW-6D, and the plume at this location is interpreted to be within the combined capture zone of MBS EW-6D and water supply wells OFB-04 (Moonbeam Drive) and OFB-51 and OFB-52 (Juvenile Hall wells), which have wellhead treatment. Extraction by these wells has reduced the area of the off-base plume.

Discharge Capacity. Prior to September 2011, all extracted and treated groundwater was injected into the aquifer using injection wells, except for water used for irrigation of roadside landscaping at Mather by Sacramento County. Due to injection well operations and maintenance issues that restricted well capacity, the Air Force began discharging treated groundwater into the nearby West Ditch in accordance with the Soil OU and Groundwater OU ROD ARARs. The West Ditch, also referred to as the West Drainage Canal, ultimately flows to Morrison Creek, a tributary to the Sacramento River. Discharge to the West Ditch was approximately 300 gpm in September 2011. In 2012, the Air Force notified CVWB of its intent to increase the monthly average discharge rate to up to 1,000 gpm to maintain optimal remediation system performance (URS, 2012c). As of 1Q14, approximately 580 gpm was being discharged to Morrison Creek via the West Ditch, although this was stopped in April 2014, as discussed in Section 2.3.1, above.

System Compliance. During the period of this five-year review, water samples were collected quarterly from the Main Base/SAC Area air stripper influent and analyzed for VOCs, TPH, general minerals, and metals. Water samples were collected biweekly from the air stripper effluent for VOCs and collected quarterly for TPH, general minerals, and metals analysis through 2Q10. After 2Q10, water samples were collected monthly from the air stripper effluent for VOCs and collected quarterly for TPH, general minerals, and metals analysis. After surface water discharge was initiated, samples were collected quarterly at the Morison Creek receiving water locations (MC-R1 and MC-R2). From 2009 through 2013, low concentrations (less than 1.0 µg/L) of VOCs were occasionally detected in the downstream (MC-R2) receiving water samples. However, the VOCs detected are not COCs for the Main Base/SAC Area Plume, and they were not detected in the effluent samples collected in conjunction with the Morrison Creek samples. From 2009 through 2013, the treatment system complied with discharge standards. In addition, the Main Base/SAC Area groundwater treatment system was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total reactive organic compounds (ROCs) based on calculations from compliance samples collected from 2009 through 2013. Discharge monitoring results are presented in the annual groundwater monitoring reports (MWH, 2010j; URS, 2011b; 2012d; 2013e; 2014b).

Institutional Controls. ICs are in place and effective. Inspections were conducted to ensure that ICs are maintained and enforced in 2012, covering the period September 2010 through January 2012 (URS, 2012b): in 2012, covering all of 2012 (URS, 2013b); and in 2014, covering all of 2013 (AFCEC, in preparation). Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

As of January 2013, all of the parcels that are or were associated with the Main Base/SAC Area Plume (Parcels A-1, A-1a, C2-C6, C-3, C-5, I-1, P-1, P-2, Q, Ut, and Uw) had been transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deeds. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deeds. For those parcels where a SLUC is planned or was executed, the new property owner will be or is required to conduct annual IC inspections and to report on those inspections to the state until the ICs at the site are terminated. If the transferee fails to provide an annual compliance report to the state in accordance with an executed SLUC, then the Air Force is responsible for monitoring and reporting on the ICs. The Air Force has exercised this responsibility in accordance with CERCLA and the NCP by conducting annual inspections and preparing annual compliance reports. Therefore, human health and the environment have been protected in compliance with the terms of the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a).

No land-use restrictions have been applied under CERCLA where the Groundwater OU plumes underlie off-base property. However, Sacramento County adopted a revised ordinance (County Code Chapter 6.28) in 2002 that governs drilling of wells to incorporate a consultation zone within 2,000 feet of any known groundwater contamination. Any permit application to drill or modify a well in this zone requires the county to consult with CVWB prior to issuing any well permits. This revised ordinance allows recommendations to the county regarding their permitting choices: to approve, approve with conditions, or deny approval for each permit application.

Mather Off-Base Water Supply Contingency Plan. The objectives of the Contingency Plan are to evaluate the effect of water supply wells on contaminant migration, establish action levels for implementing response actions of water treatment or alternate water supply, to assess the options for response actions, and to recommend appropriate response actions. Revision 2 of the Contingency Plan was finalized in 2013 to more clearly reference the regular groundwater monitoring reports for the most current information on the nature and extent of groundwater contamination; add groundwater monitoring at privately owned wells; and add a provision for an alternate water supply should groundwater at any of the private well locations become contaminated with COCs from Mather (AFCEC, 2013).

Ten drinking water supply wells have been identified as wells of concern, and the Contingency Plan was developed to monitor these wells and nearby monitoring wells. The Contingency Plan concludes that plume migration and vertical migration are best addressed through the extraction and treatment of contaminated water per the remedial action for the Main Base/SAC Area Plume. The Contingency Plan indicates that once a contaminant reaches a supply well such that concentrations in the well exceed or will exceed one-half the MCL, the Air Force will provide wellhead treatment for that well. Wellhead treatment can be terminated upon 6-months' notice once concentrations of PCE, TCE, and CCl_4 are less than one-half the MCLs for 6 months. Monitoring well sampling will continue as long as groundwater contamination exceeds MCLs or until remedial action is determined to have been completed under CERCLA. In this context, the Contingency Plan also says monitoring of each individual supply well and monitoring wells in close proximity to the supply wells may be terminated once contamination is reduced for 1 year to less than 0.5 μg/L for PCE and/or TCE and to less than 0.2 μg/L for CCl_4. Monitoring of other groundwater monitoring wells may be terminated once contamination is reduced to less than MCLs (or stays less than MCLs) for 1 year, there is adequate monitoring between any groundwater contamination exceeding MCLs and the supply well, and the well is not considered critical for protection of public health or the environment consistent with the cleanup standard established for the Groundwater OU, subject to provisions of any other monitoring requirements established under CERCLA.

Two carbon adsorption treatment systems have been installed, consistent with the Contingency Plan, at the water supply well on Moonbeam Drive owned by Cal Am and at the Sacramento County water system on Branch Center Drive, supplied by the two Juvenile Hall water supply wells. Influent concentrations for the Juvenile Hall wells have remained at concentrations that require treatment or alternate water supply under the Contingency Plan. In accordance with the Contingency Plan, carbon treatment was discontinued at the Moonbeam Drive well in June 2010, as the well had more than six consecutive monthly samples with concentrations of COCs less than one-half MCLs. The June 2012 sample collected from the Moonbeam well contained CCl_4 at a concentration exceeding the ACL. The well was shut down, and subsequent confirmation sampling prompted the re-establishment of carbon treatment. The Moonbeam Drive well was restarted with wellhead treatment in November 2012. Since carbon treatment was reestablished, none of the subsequent monthly samples has contained a CCl_4 concentration exceeding one-half the MCL. According to the Contingency Plan, these results indicate that wellhead treatment may be discontinued. However, as of October 2014, the Air Force has not proposed carbon treatment cessation at this location, and Cal Am has not operated the well since June 2014. COCs have not been detected in any effluent samples from the Juvenile Hall or Moonbeam Drive well treatment systems; effluent samples are collected when breakthrough is detected in the sample collected between the two carbon vessels (midfluent).

Samples collected quarterly from four of the other seven Cal Am water supply wells periodically contained detections of one or more Mather COCs during the period of this five-year review. At the Mars Way and Gould Way wells, which operated intermittently, concentrations of TCE and/or PCE ranged from not detected to less than 0.5 µg/L. At the Nut Plains well, PCE was detected in samples collected during three of the four quarters of 2012 (maximum estimated concentration of 0.1 µg/L) but was not detected during any other sampling event during the period of this five-year review. At the South Port well, PCE was detected in one sample in 2012 at an estimated concentration of 0.069 µg/L, and 1,1-DCE was detected in six of the eight samples (maximum estimated concentration of 0.38 µg/L in 2012) collected at the well between 2012 and 2013. The 1,1-DCE detections are not considered to be associated with the Mather groundwater plume because this well is located far from any known Mather VOC contamination, and this analyte is rarely detected in off-base wells. The PCE, TCE, and 1,1-DCE concentrations detected in samples collected from these four Cal Am wells have been far less than their respective MCLs, and further action has not been required in accordance with the Contingency Plan (AFCEC, 2013).

In addition to monitoring the drinking water supply wells owned by Cal Am or Sacramento County, selected privately owned wells west and south of Mather have been monitored by CVWB or Air Force since 1979. During the 1980s the Air Force provided bottled water for on-site domestic uses and paid for some potable water connections where wells had COC concentrations exceeding the California action levels at that time. Groundwater monitoring and the provision of an alternate water supply, should groundwater at any of the privately owned wells prove to be impacted by Mather COCs, were included in Revision 2 to the Contingency Plan (AFCEC, 2013).

Groundwater from the privately owned water supply wells are used for residential, agricultural, or industrial purposes. The privately owned wells are within approximately 0.50 mile downgradient and 0.25 mile cross-gradient from the Mather groundwater contaminant plumes and are generally sampled annually with the exception of a few wells that are sampled quarterly. During the period of this five-year review, detections of various COCs, including TCE, PCE, CCl_4, and cis-1,2-DCE, were reported in groundwater samples collected from the privately owned wells; however, none of the detections exceeded an MCL or were at wells used for potable purposes, such as drinking, cooking, or bathing (MWH, 2010j; URS, 2011b; 2012d; 2013e; 2014b).

Eighteen privately owned wells (OFB-69 through OFB-86) were sampled for the first time during the period of this five-year review to supplement the existing monitoring data from within and far downgradient from the Southwest Lobe TCE plume. With the exception of OFB-72, no COCs have been detected in samples collected from these wells. OFB-72 has been sampled quarterly since 2Q09, and TCE concentrations have ranged from 0.7 to 3.8 µg/L. PCE and cis-1,2-DCE have also been detected at OFB-72 but concentrations have all been less than 1 µg/L. Water from OFB-72 is used by Teichert for dust control purposes and is not used for drinking.

Progress Toward Meeting RAOs. The results of performance monitoring of the Main Base/SAC Area Plume remedial action since the last five-year review have demonstrated effective COC removal from the aquifer, progress toward meeting COC ACLs, and capture of the majority of the plume. The calculated total VOC mass removed by the treatment system from 1998 through the end of 2013 was approximately 3,859 pounds with nearly 10.5 billion gallons of groundwater extracted and treated (URS, 2014b). During 2013, approximately 80 pounds of VOCs were removed from groundwater by the Main Base/SAC Area groundwater treatment plant. For comparison, during 2008, approximately 90 pounds of VOCs were removed. The decrease in efficiency over time, in terms of pounds of contaminant mass removed per gallon of water extracted, is likely to continue in the future as COC concentrations continue to decrease at the extraction wells. Decreasing efficiency is typical for most groundwater extraction and treatment systems that have been operating for 10 years or longer.

Continued monitoring will help to confirm trends and future plume capture. COC concentrations have decreased to less than ACLs at several monitoring and extraction wells. Groundwater extraction at four extraction wells (MBS EW-6ABu, MBS EW-7ABu, MBS EW-8B, and MBS EW-12AB) was discontinued in February 2010, although one well (MBS EW-7ABu) was restarted in 2013 to address the COC concentrations detected at nearby monitoring well MAFB-405. In addition, cessation of groundwater extraction at four additional extraction wells (MBS EW-1B, MBS EW-4B, MBS EW-5B, and MBS EW-6B) was recommended in the *Annual and Fourth Quarter 2013 Mather Groundwater Monitoring Report, Former Mather Air Force Base, California* (URS, 2014b); those four wells were shut down on 28 March 2014. The treatment system has also been successful at meeting discharge standards for the treated groundwater and for air emissions, and the flexibility of water discharge from the plant has been enhanced with the addition of a surface discharge option.

ICs have been implemented for the Main Base/SAC Area Plume and are monitored annually to meet the RAOs of (1) preventing human exposure to groundwater with concentrations exceeding the ACLs that are specified in the Soil OU and Groundwater OU ROD, (2) protecting the integrity of the groundwater remedial actions and systems, including the associated monitoring systems, and (3) preserving access for the Air Force, EPA, and the State of California to the site, the remedial systems, and associated monitoring systems. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

Capture zone analyses conducted within the five-year review period have helped to confirm capture of a majority of the plume (MWH, 2010j; URS, 2011b; 2012d; 2013e; 2014b). MBS EW-13BuB captures almost the entire Unit B Southwest Lobe TCE plume (Figure 7-3), but there is some uncertainty that a small portion is not being captured. TCE concentrations at MAFB-460Bd increased during the five-year review period (through September 2014), and TCE concentrations at co-located MAFB-460Bs increased the last two quarters of 2013 with similar concentrations reported in 2014. While the increasing concentrations may indicate that capture is not complete, TCE concentrations have remained less than the ACL at these locations, which are downgradient of the plume. TCE has not been detected vertically downgradient in Unit D at well MAFB-462, which is co-located with MAFB-460Bs/Bd. At industrial supply well OFB-72, the water from which is not used for drinking, TCE concentrations have decreased from the historical maximum reported in 2009 and have never exceeded the MCL. Capture at MBS EW-13BuB is preventing the downgradient migration of groundwater containing TCE at concentrations exceeding the ACL. The flow at MBS EW-13BuB was able to be increased approximately 15 gpm to 145 gpm in May 2014 following the shutdown of four extraction wells in March 2014. Although no land-use restrictions have been applied under CERCLA where the Main Base/SAC Area Plume underlies off-base property, the Groundwater OU remedy remains protective of human health and the environment because water from OFB-72 is not used for drinking and no other wells can be installed within 2,000 feet of the Southwest Lobe TCE plume without approval from Sacramento County (County Code Chapter 6.28).

In addition, the Air Force has maintained protectiveness through implementation of ICs and by providing wellhead treatment on affected drinking water supply wells in compliance with the Contingency Plan that was revised in 2013 (AFCEC, 2013).

7.3.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but none of the numerical standards used to establish ACLs have changed since they were established in the Soil OU and Groundwater OU ROD; and the changes in toxicity data do not result in the ACLs exceeding the NCP risk management range. Therefore, the ACLs are still considered protective of human health and the environment.

7.3.1.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

A topic of concern in previous five-year reviews was the potential commingling of the Mather groundwater contamination with perchlorate from known upgradient sources or other unknown sources. The cleanup of perchlorate from known upgradient sources is occurring through two programs, one under EPA and CVWB regulatory authority, and the other under CVWB and DTSC regulatory authority. Voluntary sampling was initiated and low concentrations of perchlorate were detected in all the Main Base/SAC Area extraction wells in 2004, in a pattern that is not compatible with a specific source area. The concentrations did not exceed 2 μg/L for the duration of this sampling, which is less than the federal MCL of 6 μg/L. The Air Force discontinued the voluntary sampling in 2010.

Perfluorinated compounds (PFCs) are chemicals that have been classified as emerging environmental contaminants and are associated with the use of aqueous film-forming foam during past fire training practices at Air Force Bases. In September 2014, influent and effluent samples were collected from the Main Base/SAC Area groundwater treatment plant and analyzed for PFCs. One compound, perfluorooctane sulfonate (PFOS), was detected in the influent (0.235 μg/L) and effluent (0.233 μg/L) samples at concentrations greater than EPA's Provisional Health Advisory Level of 0.2 μg/L (AMEC, 2014). (Note that influent and effluent samples were also collected from the AC&W and Site 7 groundwater treatment plants; however, PFOS was not detected at a concentration greater than EPA's Provisional Health Advisory Level in those samples.) As of November 2014, AFCEC is preparing a strategy for follow-up sampling.

7.3.2 Site 7 Plume

7.3.2.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Soil OU and Groundwater OU ROD (AFBCA, 1996a), as modified by the 2010 Soil OU and GW OU ESD (AFRPA, 2010a).

Remedy Performance. In June 2011, AFBCA issued an OPS report for the Site 7 Plume remedial action (AFRPA, 2011b), which received concurrence from EPA in July 2011 (EPA, 2011b). The OPS report documents that the remedial action is operating as designed and is successfully remediating groundwater contamination at the site.

Extraction well 7-EW-1, located near the toe of the plume, was redeveloped in July 2012 as its yield had decreased from roughly 40 gpm at startup in 2006 to 15 to 20 gpm in early 2012. After the 2012 redevelopment, the well operated at approximately 20 to 24 gpm; it was redeveloped again in April 2014 and as of May 2014 is operating at approximately 29 gpm. Extraction well 7-EW-2 was redeveloped in October 2010, but its yield did not increase significantly (approximately 33 gpm). Since then, the extraction rate at this location has decreased. At the end of 2013, 7-EW-2 was operating at approximately 23 gpm.

Despite the decrease in flow rates, both extraction wells are removing mass from the plume. After maximum TCE concentrations were reported in April 2007, concentrations have decreased at both wells. TCE concentrations at MAFB-372B and MAFB-448, formerly located in the toe of the plume, have decreased to less than the ACL (Figure 7-5). TCE concentrations at MAFB-371C have shown an increasing trend since 2006, and in 2Q14 the concentration was 5 µg/L. However, this concentration is not greater than the ACL and capture zones developed using groundwater potentiometric surface data in 2013 show that capture by 7-EW-1 extends past the toe of the plume and beyond MAFB-371C (URS, 2014b). In addition, the areal extent of the Site 7 Plume has decreased from 93 acres in 2008 to 66 acres in 2013 (Figure 7-5). This 29 percent reduction in plume area indicates continued progress of the remedial action.

Concentrations of TCE at MAFB-393 and MAFB-395 have decreased to less than the ACL, narrowing the upgradient portion of the ACL plume. These wells are located mid-plume near 7-EW-2, and the decreasing concentrations at these wells combined with potentiometric data corroborate capture by the extraction well. Capture zones developed using groundwater potentiometric surface data in 2013 show capture of this part of the plume by 7-EW-2 (URS, 2014b).

Monitoring well MAFB-464 was installed in 2011 downgradient of the southern extent of the Site 7 plume to better define the downgradient edge of the plume. The maximum historical TCE concentration at this location was 1.1 µg/L in 4Q12.

In 2013, only TCE and 1,2-DCA were detected at concentrations greater than their respective ACLs, whereas in the past PCE (most recently in 2010) and cis-1,2-DCE (most recently in 2011) were detected at concentrations greater than their ACLs in the Site 7 Plume.

System Compliance. Site 7 treatment system influent samples were collected quarterly for VOCs, TPH, and general minerals analyses. The effluent of the treatment system was sampled biweekly from 2009 through 2Q10 and monthly after that for VOCs and quarterly for TPH-g, TPH-d, metals, and general minerals. Between 2009 and 2013, the treatment system complied with the discharge standards established in the Soil OU and Groundwater OU ROD. In addition, the Site 7 groundwater treatment system was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). During operation, air emissions did not exceed 10 lbs/day for total ROCs based on calculations from compliance samples collected from 2009 through 2013. Discharge monitoring results are presented in the annual groundwater monitoring reports (MWH, 2010j; URS, 2011b; 2012d; 2013e; 2014b).

Institutional Controls. ICs are in place and effective. The following inspections were conducted to ensure that ICs are maintained and enforced:

- In 2012, covering the period September 2010 through January 2012 (URS, 2012b)
- In 2012, covering all of 2012 (URS, 2013b)
- In 2014, covering all of 2013 (AFCEC, 2014)

Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

In November 2012, the primary parcel (A-1) associated with the Site 7 Plume was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. Once the SLUC is executed, if the transferee fails to provide an annual compliance report to the state, then under CERCLA and the NCP, the Air Force is responsible for monitoring and reporting on the ICs in order to be in compliance with the terms of the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a) and to be protective of human health and the environment.

No land-use restrictions have been applied under CERCLA where the Groundwater OU plumes underlie off-base property. However, the Sacramento County adopted a revised ordinance (County Code Chapter 6.28) in 2002 that governs drilling of wells to incorporate a consultation zone within 2,000 feet of any known groundwater contamination. Any permit application to drill or modify a well in this zone requires the county to consult with CVWB prior to issuing any well permits. This revised ordinance allows recommendations to the county regarding their permitting choices: to approve, approve with conditions, or deny approval for each permit application.

Progress Toward Meeting RAOs. Performance monitoring of the Site 7 Plume remedial action since the system was restarted in December 2006 has demonstrated COC removal from groundwater, progress toward meeting COC ACLs, and capture of the plume. Since the system initially began operation in 1999, approximately 58.5 pounds of VOCs have been removed from approximately 273 million gallons of groundwater. The system has also been successful at meeting discharge standards for the treated groundwater and for air emissions. Additional monitoring will help to confirm trends and demonstrate plume capture.

ICs have been implemented for the Site 7 Plume and are monitored annually to meet the RAOs of (1) preventing human exposure to groundwater with concentrations exceeding the ACLs that are specified in the Soil OU and Groundwater OU ROD, (2) protecting the integrity of the groundwater remedial actions and systems, including the associated monitoring systems, and (3) preserving access for the Air Force, EPA, and the State of California to the site, the remedial systems, and associated monitoring systems. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

7.3.2.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but none of the numerical standards used to establish ACLs have changed since they were established in the Soil OU and Groundwater OU ROD; and the changes in toxicity data do not result in the ACLs exceeding the NCP risk management range. Therefore, the ACLs are still considered protective of human health and the environment.

7.3.2.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Perfluorinated compounds (PFCs) are chemicals that have been classified as emerging environmental contaminants and are associated with the use of aqueous film-forming foam during past fire training practices at Air Force Bases. In September 2014, influent and effluent samples were collected from the Site 7 groundwater treatment plant and analyzed for PFCs. Concentrations of PFCs were detected at concentrations greater than 100 nanograms per liter (ng/L) (AMEC, 2015); however, no concentrations from the Site 7 Plume exceeded EPA's Provisional Health Advisory Level of 0.2 μg/L (AMEC, 2014). (Note that influent and effluent samples were also collected from the AC&W and Main Base/SAC Plume groundwater treatment plants; PFCs were not detected in the AC&W samples. See Section 7.3.1. 3 for a discussion of PFCs in the Main Base/SAC Plume.) As of November 2014, AFCEC is preparing a strategy for follow-up sampling.

7.3.3 Northeast Plume

7.3.3.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Soil OU and Groundwater OU ROD (AFBCA, 1996a), as modified by the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a).

Remedy Performance. In March 2011, AFRPA issued an OPS report for the Northeast Plume remedial action (AFRPA, 2011c), which received concurrence from EPA in July 2011 (EPA, 2011b). The OPS report documents that the remedial action is operating as designed and is successfully remediating groundwater contamination at the site.

Groundwater monitoring has occurred at wells throughout the area of the Northeast Plume since the Soil OU and Groundwater OU ROD was issued. Only two of the five COCs have exceeded ACLs in this time. Since the issuance of the Soil OU and Groundwater OU ROD, only nine wells have had concentrations of COCs that have exceeded the ACLs. In 2013, only three wells contained concentrations of COCs exceeding ACLs. Although TCE is not a COC for the Northeast Plume, it consistently has been detected at a concentration greater than the MCL at MAFB-132 since 4Q10. Detections of TCE less than the MCL have been detected in other Northeast Plume wells. The TCE detections may have been the result of the breakdown of PCE and do not indicate a new release from the landfill.

Since the third five-year review, the plume area has decreased from 28 to 15 acres (a decrease of 46 percent), and since implementation of the Northeast Plume remedy, the areal extent has decreased by 89 percent (133 acres in 1996). A visual comparison of the plume contours in 4Q08 and 4Q13 shows the reduction in plume area (Figure 7-6). The areas where COCs currently exceed ACLs are beneath and downgradient of landfill Sites LF-03 and LF-04. A decrease in the water table elevation has resulted in the restriction of the COCs to the dominantly fine-grained overbank deposits of Unit C. The hydrogeologic conceptual model indicates that it is likely that less dilution of the COCs will occur in Unit C resulting in a smaller but possibly higher-concentration plume than in the past when the water table was in the coarser-grained Unit B, which has a greater hydraulic conductivity. This appears to be reflected in the current plume configuration, where COC concentrations in Unit C well MAFB-398C, near Site LF-03, have been increasing as the plume area decreases.

Figure 7-7 displays time concentration plots for MAFB-132 and MAFB-398C. MAFB-132 has historically had the highest concentrations of PCE and cis-1,2-DCE in the Northeast Plume. Figure 7-7 shows generally increasing PCE and cis-1,2-DCE concentrations at MAFB-132 from 2009 through 4Q13. The vertical extent of the plume in this area is defined by MAFB-400, completed in the deeper portion of Unit C near Site LF-04. MAFB-400 has consistently had PCE and cis-1,2-DCE concentrations less than ACLs throughout its monitoring history. These results do not indicate a significant downward movement of COCs through this part of Unit C.

Figure 7-7 also shows increasing PCE and cis-1,2-DCE concentrations at MAFB-398C since mid-2009. In late 2009, the cis-1,2-DCE concentration increased to greater than the ACL for the first time, and in mid-2010, the PCE concentration exceeded the ACL for the first time at MAFB-398C. This well is screened in Unit C, and the vertical and horizontal extent of COCs exceeding ACLs are not defined at this location. However, approximately 70 feet of fine-grained, overbank deposits exist between the screened-interval at MAFB-398C and the uppermost transmissive units of the LMT, limiting downward migration of contaminants.

Water table monitoring well MAFB-438 was installed in August 2008 along the northern property line to the northwest of MAFB-132 to assess the northern extent of the plume. Between 2009 and 2013, the PCE and cis-1,2-DCE concentrations were less than the ACLs, which shows that the Northeast Plume is within the boundary of the former base property (Figure 7-6). The plume is not likely to migrate northward because the potentiometric gradient interpreted from the monitoring network indicates a consistent southerly to southwesterly groundwater flow direction in the area of the Northeast Plume.

Predictive Modeling. As documented in the *Third Five-Year Review Report* (URS, 2010) and the memorandum *Predictive Trend Analysis for the Northeast Plume Contaminants of Concern* (AFRPA, 2010d), decreasing COC concentration trends in 2007 and 2008 allowed a projection of when (approximately 2025 based on extrapolation of a best-fit exponential trend line) ACLs may be achieved in the Northeast Plume. While COC concentrations (specifically, PCE and cis-1,2-DCE) at most Northeast Plume wells have continued to decrease since 2009, they have been increasing at concentrations greater than ACLs at MAFB-132 and MAFB-398C; therefore, an updated prediction of when ACLs may be achieved based on trend analysis cannot be made at this time (Figure 7-7).

Institutional Controls. ICs are in place and effective. Inspections were conducted in 2012, covering the period September 2010 through January 2012 (URS, 2012b); 2012, covering all of 2012 (URS, 2013b); and 2014, covering all of 2013(AFCEC, 2014), to ensure that ICs are maintained and enforced. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. With regulatory agency notification and approval, one groundwater monitoring well was installed in October 2012.

In November 2012, the parcel (A-3) associated with the Northeast Plume was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. In June 2013, a SLUC was executed for this parcel; therefore, the new property owner is required to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. If the transferee fails to provide an annual compliance report to the state in accordance with the executed SLUC, then the Air Force is responsible for monitoring and reporting on the ICs. The Air Force has exercised this responsibility in accordance with CERCLA and the NCP by conducting annual inspections and preparing annual compliance reports. Therefore, human health and the environment have been protected in compliance with the terms of the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a).

No land-use restrictions have been applied under CERCLA where the Groundwater OU plumes underlie off-base property. However, Sacramento County adopted a revised ordinance (County Code Chapter 6.28) in 2002 that governs drilling of wells to incorporate a consultation zone within 2,000 feet of any known groundwater contamination. Any permit application to drill or modify a well in this zone requires the county to consult with CVWB prior to issuing any well permits. This revised ordinance allows recommendations to the county regarding their permitting choices: to approve, approve with conditions, or deny approval for each permit application.

Progress Toward Meeting RAOs. The RAO identified in the Soil OU and Groundwater OU ROD for the Northeast Plume to protect the public from inadvertent significant exposure to contaminated groundwater is being achieved. ICs are in place to protect the public from unacceptable exposure to contaminated groundwater, and data from the well network indicates the Northeast Plume is within the boundary of the former base property. Since the third five-year review, the areal extent of the Northeast Plume has decreased; however, COC concentrations at two wells (MAFB-132 and MAFB-398C) have been increasing and a prediction of when cleanup levels may be achieved based on trend analysis cannot be made at this time (Figure 7-7). The vertical extent of the plume in the area of MAFB-132 is defined by MAFB-400, completed in the deeper portion of Unit C near Site LF-04. If the increasing contaminant trend at MAFB-398C continues, additional monitoring wells may be necessary to define the horizontal and vertical extent of the ACL plume. However, in 2014, PCE and cis-1,2-DCE concentrations decreased at MAFB-132 and MAFB-398C, including to less than ACLs at MAFB-398C. In accordance with the Soil OU and Groundwater OU ROD, if at any time monitoring or modeling indicates that the contaminants will not meet ACLs within a reasonable time, or at least 40 years from the date of the ROD (i.e., by the year 2036), or that significant migration of the contaminants may occur at concentrations greater than the ACLs which impacts public health or the environment, active remediation will be reconsidered.

ICs have been implemented for the Northeast Plume and are monitored annually to meet the RAOs of (1) preventing human exposure to groundwater with concentrations exceeding the ACLs that are specified in the Soil OU and Groundwater OU ROD, (2) protecting the integrity of the groundwater remedial actions and systems, including the associated monitoring systems, and (3) preserving access for the Air Force, EPA, and the State of California to the site, the remedial systems, and associated monitoring systems. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

7.3.3.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but none of the numerical standards used to establish ACLs have changed since they were established in the Groundwater OU ROD; and the changes in toxicity data do not result in the ACLs exceeding the NCP risk management range. Therefore, the ACLs are still considered protective of human health and the environment. As discussed in 7.3.3.1, although TCE is not a COC for the Northeast Plume, it consistently has been detected at a concentration greater than the MCL of 5 μg/L at MAFB-132 since 4Q10. The maximum TCE concentration reported at this well in 2013 was 7.6 μg/L. Based on this concentration and the TCE RSL of 0.49 μg/L, an ILCR of approximately 15 in 1 million is estimated, which is within the NCP risk management range alone and cumulatively (approximately 28 in 1 million) with the other Northeast Plume COCs. TCE will continue to be monitored along with the Northeast Plume COCs and is not expected to persist longer than those COCs or cause unacceptable risk to human health.

7.3.3.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.4 OU 3 (Soil OU)

7.4.1 Site WP-07/FT-11

7.4.1.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Soil OU and Groundwater OU ROD (AFBCA, 1996a), as modified by two ESDs (AFBCA, 1998a; AFRPA, 2010a).

Remedy Performance. In April 2007, the SVE treatment system was shut down, and a BV system was started, as volatile contaminant concentrations had significantly decreased. During the period of this five-year review, the BV system operated until May 2009 when it was shut down to conduct respiration monitoring and rebound sampling at the site. Respiration monitoring was conducted at the site in May, June, July, and August 2009 and March 2010. Subsurface oxygen and carbon dioxide levels indicated active biodegradation was occurring (URS, 2011c). Oxygen levels were observed greater than 5 percent at most wells monitored. The BV system was not restarted, as oxygen levels within the subsurface at Site WP-07/FT-11 were sufficient to support continued biodegradation of residual petroleum hydrocarbons without the need for continued active BV.

A report to demonstrate that the vadose zone at Site WP-07/FT-11 had been remediated and did not pose a future unacceptable threat to groundwater was prepared (URS, 2011a). The evaluation presented in the report led to the conclusion that continued in situ remediation was not necessary and that closure of the vadose zone portion of the active remedy (i.e., SVE/BV) was appropriate (URS, 2011a). However, continued implementation of the ICs established in the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a) is necessary, as well as the ongoing, post-closure maintenance and monitoring of the Site WP-07 landfill and the groundwater extraction and treatment of the Site 7 Plume.

In 2012, the SVE/BV wells, soil vapor monitoring wells, SVE/BV system, and pipelines were decommissioned (URS, 2012a), except for a few BV wells retained for use by the Groundwater Monitoring Program. To maintain the integrity of the landfill cap impermeable layer, wells that penetrated it were decommissioned differently than those outside the landfill cap boundaries. Only the upper foot of these wells was excavated and removed. The well was then grouted and the sealing material was allowed to spill over into the excavation, forming a cap. After the sealing material had set, the excavation was filled with compacted native soil. Any other feature associated with the well (e.g., well box or vault) was removed; the excavation backfilled with native soil or other appropriate fill material; and the surface finished to match the surrounding area. All underground SVE piping was left in place and capped below the ground surface. All aboveground piping was removed and disposed of as construction debris.

SVE System Compliance. The Site WP-07/FT-11 SVE system did not operate during the period of this five-year review and was decommissioned in 2012; therefore, the ARARs governing air emissions were not applicable during the review period.

Landfill WP-07. Quarterly inspections of Site WP-07 were performed during the period of this five-year review. Overall, the cap and drainage system were observed to be in good condition. In 2012, small rodent holes were evident but they did not extend to the cap (URS, 2013d). One small rodent hole had collapsed on itself causing a shallow hole approximately 6 inches deep and 18 to 24 inches in diameter. The hole was manually extended to evaluate the condition of the cap liner. The liner was found to be intact and the hole was backfilled and compacted to the surrounding grade. Another hole was observed in April 2014 but was outside of the landfill cap. The hole was approximately 2.5 feet deep and 1.5 feet in diameter and was backfilled and compacted to the surrounding grade in May 2014. No issues with the drainage system were observed during the period of this five-year review.

Potholes or ruts were commonly observed in the all-weather access road from Excelsior Road to the landfill and were filled and compacted as necessary. In addition, stopcocks, valves, and sample ports damaged by wildlife or the sun were replaced as necessary.

In June 2013, an aerial survey of Site WP-07 was conducted in accordance with the post-closure landfill requirement for the completion of an aerial survey every 5 years (Montgomery Watson, 1999d; MWH, 2010h). The purpose of the aerial survey was to measure elevation data across the landfill cap at Site WP-07. The elevation data were compared to elevation data from the 2008 survey to identify areas of settlement. Results of the 2013 survey indicate that no areas of the Site WP-07 landfill cap have any significant settlement of 0.5 foot or greater (URS, 2013c).

There are two areas in the northern portion of the site outside of the landfill cap that indicate settlement of greater than 0.5 foot (maximum 0.8 foot) between the 1999 and 2013 surveys. These two areas are outside of the cap area that was repaired in 2007. Neither of these settlement areas has had an impact on drainage or has caused erosion. This conclusion is confirmed by the results of the quarterly field inspections.

During future landfill inspections, care will be taken to monitor any areas of known settlement on the landfill cap to verify the cap is intact and drainage is maintained. Any observed areas of potential settlement, recommended corrective actions, and repair activities to correct settlement will be noted in the quarterly landfill inspection reports.

Landfill Gas Monitoring. During (and prior to) the period of this five-year review, post-closure gas monitoring indicates that little methane is being produced at the Site WP-07 landfill. From 2009 through 2013, methane concentrations measured at the four gas migration probes and the nine passive gas vents did not exceed the compliance level of 5 percent by volume in air. VOC emissions from the gas vents were also monitored from 2009 through 2013, and all results were less than the 15 parts per million by volume (ppmv) action level for VOCs that would trigger sampling for laboratory analysis. Compliance monitoring results are reported in the annual post-closure landfill inspection and gas monitoring reports (MWH, 2010k; URS, 2011d; 2012e; 2013d; 2014c).

Through 2Q13, landfill gas monitoring (field measurements) was conducted quarterly at Site WP-07. Based on a history of low and compliant methane and VOC field measurements, the frequency of landfill gas monitoring at Site WP-07 has been reduced from quarterly to annually. Beginning in 2014, landfill gas monitoring will only be conducted during the first quarter at Site WP-07. Quarterly post-closure inspections will continue to be conducted.

Groundwater Monitoring. VOC monitoring of groundwater beneath Site WP-07 satisfies the dual requirements for detection and corrective action monitoring for VOCs. A discussion regarding VOC monitoring and remediation of the Site 7 VOC plume is presented in Section 7.3.2. Detection and/or evaluation monitoring for non-VOCs is also part of the post-closure groundwater monitoring program at Site WP-07. Non-VOCs analyzed include metals, general minerals, TPH, PAHs, and pesticides. Two metals detected between 2009 and 2013 exceeded a calculated background concentration: chromium at 7-PZ-37 in 2Q09 and thallium at MAFB-044 in 2Q10. Neither detection was considered to be the result of a release from the landfill (MWH, 2010j; URS, 2011b). TPH-d was not detected at concentrations exceeding its ACL. PAHs and pesticides were not detected in any sample collected at Site WP-07 between 2009 and 2013.

Institutional Controls. ICs are in place and effective. Inspections were conducted in 2012, covering the period September 2010 through January 2012 (URS, 2012b); in 2012, covering all of 2012 (URS, 2013b), and in 2013/2014, covering 2013 (AFCEC, 2014), to ensure that ICs are maintained and enforced. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. The perimeter security fences have remained intact and signs visible and in good condition.

In November 2012, one of two parcels associated with Site WP-07 has been transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel (A-1) that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. Once the SLUC is executed, if the transferee fails to provide an annual compliance report to the state, then under CERCLA and the NCP, the Air Force is responsible for monitoring and reporting on the ICs in order to be in compliance with the terms of the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a) and to be protective of human health and the environment. The other parcel (A-2) was assigned to, and accepted by, the DOI in January 2013 but had not yet been transferred to Sacramento County as of October 2014.

Progress Toward Meeting RAOs. During the last 5 years, the SVE/BV system at Site WP-07/FT-11 achieved the RAO of mitigating the residual source of vadose zone contamination that posed an unacceptable threat to groundwater quality. Consequently, the vadose zone portion of the Site WP-07/FT-11 active remedy (i.e., SVE/BV) was closed, and the SVE/BV system was decommissioned.

The post-closure maintenance of the landfill cap and landfill gas monitoring at Site WP-07 are meeting the RAO of compliance with ARARs established in the Soil OU and Groundwater OU ROD, including portions of the CFR 40, Part 258, and CCR Titles 14 and 23. Because of the compliant methane and VOC field measurements, the frequency of landfill gas monitoring at Site WP-07 was reduced from quarterly to annually effective after 2Q13.

ICs have been implemented at Site WP-07/FT-11 and are monitored annually to meet the RAOs of (1) protecting the integrity of the soil remedial actions and systems, including the associated monitoring systems, and (2) preserving access for the Air Force, EPA, and the State of California to the site, the remedial systems, and associated monitoring systems. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. The Site WP-07/FT-11 SVE/BV system and components have been decommissioned; therefore, the ICs related to protection of those components no longer apply, except for the few BV wells that were not decommissioned because they were retained for use by the Groundwater Monitoring Program.

7.4.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid?

Yes (see Section 7.1). During the period covered by this five-year review, there were changes in toxicity data (e.g., TCE, PCE, and cis-1,2-DCE), but the changes do not affect the protectiveness of the remedy and have not resulted in development of enforceable standards for soil vapor. ICs to prevent potential unacceptable exposure to VOCs from soil vapor inhalation are in place and effective, and SVE/BV operated until narrative soil cleanup levels for groundwater protection were achieved as documented in the *Site 7/11 Soil Vapor Extraction/Biovent System Closure Report* (URS, 2011a).

Relative to landfills, as discussed in the second and third five-year reviews, the ARARs from CCR Titles 14 and 23 have been revised since they were selected as ARARs during preparation of the Soil OU and Groundwater OU ROD. These regulations have been combined, revised, and recodified into Title 27 of the CCR. Only the ARARs addressing the post-closure status of Site WP-07 remain applicable or relevant and appropriate. Table 7-2 summarizes these ARARs and provides a general Title 27 citation for cross-reference. However, the cross-reference may not be an exact equivalent to the ARAR cited in the RODs. Some of the sections were reworded or edited or may have additional content. Consequently, the current regulatory citations are not necessarily equivalent to the ARARs, and it is possible that some of the Title 27 citations might not contain ARAR (i.e., substantive) portions of the regulations. As the ARAR citations are the same for Sites LF-03 and LF-04, this discussion is also relevant to those two sites (see Section 7.5).

Table 7-2. Recodified Post-Closure Landfill ARARs

ARARs Citation	Title 27 Citation	Notes
14 CCR 17766 Emergency Response Planning	27 CCR 21130	
14 CCR 17767 Site Security	27 CCR 21135	
14 CCR 17773(b) to (e) Final Cover Design	27 CCR 21140	Potentially relevant to post-closure maintenance

Table 7-2. (Continued)

ARARs Citation	Title 27 Citation	Notes
14 CCR 17774((a) & (c) to (h) Construction Quality Assurance	27 CCR 20324	Potentially relevant to post-closure maintenance
14 CCR 17776(a), (c) to (f) Final Grades	27 CCR 21142, 21769	Potentially relevant to post-closure maintenance
14 CCR 17777(a) to (c) Final Site Face	27 CCR 21090, 21142, 21145	Potentially relevant to post-closure maintenance
14 CCR 17778(a) & (c) to (j), Final Drainage	27 CCR 20365, 21150, 21769	Potentially relevant to post-closure maintenance
14 CCR 17779(a) & (c) to (i), Slope Protection and Erosion Control	27 CCR 21090	Potentially relevant to post-closure maintenance
14 CCR 17783, Gas Monitoring and Control	27 CCR 20918, 20921, 20937, 21160	
14 CCR 17788, Post-closure Maintenance	27 CCR 21180(a)	
14 CCR 17796, Post-closure Land Use	27 CCR 21190	
23 CCR 2511(d), Applicability	27 CCR 20090	
23 CCR 2541(d), Containment Materials	27 CCR 20320	Potentially relevant to post-closure maintenance
23 CCR 2546(a) & (c) to (f), Drainage Control	27 CCR 20365	
23 CCR Article 5, Groundwater Monitoring	27 CCR 20380 – 20435, 22222	
23 CCR 2580(a), Post-closure Maintenance	27 CCR 20950(a)	
23 CCR 2580(d), Monuments	27 CCR 20950(d)	
23 CCR 2580(e), Vegetation	27 CCR 20950(e)	
23 CCR 2581, Maintenance of Final Cover	27 CCR 21090	
23 CCR 2597, Post-closure Maintenance	27 CCR 21769	

ARAR = applicable or relevant and appropriate requirement
CCR = California Code of Regulations

Based on the continued protectiveness of the ARARs identified in the ROD and satisfaction of CalRecycle and CVWB that the listed ARARs are equivalent to the recodified regulatory requirements, these ARARs are still protective.

7.4.1.3 Question C. Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.4.2 Site ST-37/ST-39/SS-54

7.4.2.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Soil OU and Groundwater OU ROD (AFBCA, 1996a), as modified by the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a).

Remedy Performance. The SVE system did not operate at Site 37/39/54 during the first half of 2009 during a period of rebound that began in December 2008. Beginning in mid-July 2009, the SVE system began operating at SVE wells 37-PW-05 and 37-PW-06 (Figure 4-8), even though pilot testing at these wells in December 2008 indicated that the lower soil permeability in the shallow and intermediate zones at the site would likely result in low and unsustainable mass removal (MWH, 2009f). The extraction rate of hydrocarbons constituents was approximately 78 lbs/day in July 2009 but decreased to 5.1 lbs/day by December 2009. The decrease in mass removal indicated effective remediation of the vadose zone had become limited and pursuit of closure was recommended (MWH, 2010l). In January 2010, the SVE system was shut down.

Because the primary contaminants at Site 37/39/54 are biodegradable petroleum hydrocarbons, the SVE system was reconfigured in October 2010 to allow air injection for active BV. The BV system began operation on 13 October 2010 with injection of air into three wells (37-PW-07 at 7 feet, 37-PW-07 at 23 feet, and 39-SVE-01C at 4 feet) (URS, 2011c). In mid-July 2011, the BV system was shut down for respiration testing and rebound monitoring. The respiration testing results suggested that injecting air may not be necessary because oxygen concentrations did not appear to decrease and carbon dioxide concentrations did not appear to increase for the 48-hour period monitored after cessation of active pumping. However, elevated TPH-g concentrations implied continued active air injection was appropriate (URS, 2012f).

In February 2012, the BV system was restarted, and air flow to all wells was increased from approximately 9 cfm to approximately 35 cfm. Soil vapor monitoring well 37-PW-03 was also plumbed to the BV system to allow for air injection at this well. This location and the higher flow rates were expected to increase air flow in the higher TPH-g concentration area in the southwest portion of the site (URS, 2013f). The system was shut down for rebound monitoring at the end of June 2012. Soil vapor samples were collected in October 2012. Five of seven TPH-g concentrations were much higher (2.7 to 500 times higher) than September 2011 results but were mostly within the historical range of results. Lateral and vertical TPH-g extents were mostly defined or showed decreasing trends. In addition, 2012 benzene concentrations were lower than previous years.

The BV system was restarted in late February 2013 and operated until mid-December 2013 when it was shut down for respiration testing and rebound monitoring. As of October 2014, the BV system remains shut down. Based on the following, assessment of the vadose zone for closure will be conducted in 2014:

- Benzene concentrations and other BTEX compounds are mostly less than groundwater cleanup level equivalent (GCLE) [2] soil vapor concentrations.

[2] To assess the likelihood that a residual VOC could impact groundwater at a concentration greater than an ACL, a GCLE is calculated (MWH, 2010a). The first step is to calculate the equivalent soil vapor concentration associated with a soil moisture concentration set at the ACL for each analyte of concern. The equivalent soil vapor concentration is calculated assuming equilibrium partitioning between the soil vapor and soil water phases at 20 degrees Celsius, using the following equation: $C_a = (C_w \times 24.055 \times H)/MW$
Where:

C_w is the soil water concentration (milligrams per liter), set to equal the ACL
C_a is the equivalent soil vapor concentration (parts per million by volume)
MW is the molecular weight of the chemical (grams per mole)
H is the Henry's Law constant for the chemical (unitless)

If the measured soil vapor concentration is less than the calculated groundwater cleanup level equivalent soil vapor concentration (C_a), the residual contamination associated with that sample cannot impact the groundwater at a concentration greater than the ACL.

- Groundwater monitoring well sample data indicate no TPH-g or BTEX impact to groundwater from residual petroleum hydrocarbons in the vadose zone.
- Sufficient oxygen is present in the subsurface such that active BV is not necessary.

As part of the site closure recommendation, the risk to human health from the vapor intrusion pathway will be evaluated. If site soil vapor data indicate that all of the soil vapor concentrations for each COC are compatible with unrestricted land use, then the ICs related to preventing exposure to VOC-contaminated shallow soils will no longer be required by the remedy for Site ST-37/ST-39/SS-54.

SVE System Compliance. During the period of this five-year review, the Site ST-37/ST-39/SS-54 SVE system only operated from mid-July 2009 until 21 January 2010, although it was operational at other times with only the Site ST-29/ST-71wells (the SVE/BV system at Site ST-37/ST-39/SS-54 also remediated Site ST-29/ST-71, a non-CERCLA site). The SVE system was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs or 0.69 lb/day for benzene based on calculations from monthly compliance samples. The compliance monitoring results were reported in the 2009 and 2010 annual SVE/BV reports (MWH, 2010l; URS, 2011c).

Monthly sampling is not required for BV systems where air is being injected because there are no vapor treatment units, and therefore no point-source vapor emissions.

Institutional Controls. ICs are in place and effective. Inspections were conducted in 2012, covering the period September 2010 through January 2012 (URS, 2012b); in 2012, covering all of 2012 (URS, 2013b); and in 2013, covering all of 2013 (AFCEC, 2014), to ensure that ICs are maintained and enforced. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. With regulatory agency notification and approval, a trench was dug to plumb an existing vapor well (37-PW-03) to the remediation system and was backfilled in March 2012.

In November 2012, the parcel associated with Site ST-37/ST-39/SS-54 (Parcel A-1) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. Once the SLUC is executed, if the transferee fails to provide an annual compliance report to the state, then under CERCLA and the NCP, the Air Force is responsible for monitoring and reporting on the ICs in order to be in compliance with the terms of the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a) and to be protective of human health and the environment.

Progress Toward Meeting RAOs. During the last 5 years, the SVE/BV system at Site ST-37/ST-39/SS-54, which includes remediation of Subsites OT-23B and OT-23D, has made progress toward meeting the RAO of mitigating the residual source of vadose zone contamination that may pose an unacceptable threat to groundwater quality, and an assessment of the vadose zone for closure is scheduled for preparation in 2014.

Despite the low permeability and high moisture content of the soil at Site ST-37/ST-39/SS-54, a total of approximately 2,570 pounds of contaminants were estimated to have been removed between mid-July 2009 and 21 January 2010 when the system was shut down and converted to BV. Mass removed was not calculated for BV operations.

ICs have been implemented at Site ST-37/ST-39/SS-54 and are monitored annually to meet the RAOs of (1) preventing unacceptable human exposure to soil vapor or residual contamination, (2) protecting the integrity of the soil remedial actions and systems, including the associated monitoring systems, and (3) preserving access for the Air Force, EPA, and the State of California to the site, the remedial systems, and associated monitoring systems. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

7.4.2.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid?

Yes (see Section 7.1). During the period covered by this five-year review, there were changes in toxicity data (e.g., CCl_4, cis-1,2-DCE, PCE, and TCE), but they do not affect the protectiveness of the remedy and have not resulted in development of enforceable standards for soil vapor. ICs to prevent potential unacceptable exposure to VOCs from soil vapor inhalation are in place and effective, and the SVE/BV system will operate until narrative soil cleanup levels for groundwater protection are achieved.

7.4.2.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.4.3 Site SD-57

7.4.3.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Soil OU and Groundwater OU ROD (AFBCA, 1996a), as modified by the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a).

Remedy Performance. The SVE system at Site SD-57 was offline from early December 2008 until late February 2009 due to a failure of the system's blower and motor, when it was restarted with GAC while system compliance samples were collected. The system was turned off following the February compliance sampling and remained offline while the samples were analyzed by the laboratory. The GAC was removed from the system upon receipt of analytical data from the laboratory and confirmation that the ILCR did not exceed 1 in 1 million (MWH, 2010l). The system was restarted on 16 March 2009 and operated until 27 May 2009 when the SVE system was shut down for rebound sampling. The SVE system was restarted on 15 July 2009 without GAC and operated until 22 January 2010, when it was shut down because of limited effectiveness and anticipated site closure (URS, 2011c).

Soil vapor samples were collected in September 2011, and 10 of 13 wells sampled had one or more contaminants at a concentration greater than a GCLE, indicating that the SVE system should be restarted (URS, 2012f). The SVE system remained offline until early December 2011 when it was restarted with GAC. However, because of the low VOC emission rates (less than 10 lbs/day), the GAC was removed at the end of December 2011. The SVE system operated with focused extraction at 57-SVE-07B and 57-SVE-07C (near the highest concentration monitoring wells) until the end of June 2012 when it was shut down for rebound monitoring. Of the 19 samples collected from 15 wells in 2012, 17 samples from 13 wells had one or more contaminants at a concentration greater than the GCLE. Most 2012 concentrations were less than but similar to 2011 concentrations (URS, 2013f). Although system influent concentrations and mass removal rates were low, concentrations of TCE and PCE remained at higher than expected concentrations at 57-MPMP-9 and 57-MPMP-10, both within 50 feet of the SVE wells nested at 57-SVE-07 (Figure 4-9).

Consequently, the SVE system was restarted in mid-January 2013 with GAC, but the GAC was removed in mid-June 2013 because of the low VOC emission rates (less than 10 lbs/day). At the end of July 2013, the SVE system was shut down for rebound monitoring. Thirteen soil vapor samples from 9 of 20 wells sampled in 2013 had one or more contaminants at a concentration greater than the GCLE. However, preliminary vadose zone modeling results indicated that these residual concentrations would not significantly impact groundwater or extend groundwater remediation time (URS, 2014d).

In April 2014, a draft closure report was submitted for regulatory agency review; the report documented that no further treatment of the vadose zone was necessary at Site SD-57. However, at the request of the regulatory agencies, additional confirmation soil vapor samples were collected from some vapor wells in August 2014, particularly from key wells that had not been sampled for several years. These data indicated some unexpectedly high TCE rebound and residual soil vapor concentrations that may impact groundwater. Therefore, the closure report was postponed and SVE operations resumed in September 2014.

There are 11 Site SD-57 vapor wells with screened intervals extending shallower than 20 feet bgs that may be used to assess potential indoor air risk due to VOCs in shallow soil vapor. The most recent soil vapor data from these wells shows that three of the wells (57-SVE-06A, 57-SVE-07A, and 57-MPMP-10) have PCE and TCE present at concentrations greater than the 1E-06 industrial lifetime excess cancer risk shallow soil vapor screening levels of 0.307 ppmv for PCE and 0.558 ppmv for TCE. Only wells 57-SVE-07A and 57-MPMP-10 have TCE present at concentrations greater than the noncancer hazard index value of 1.0 concentration of 1.5 ppmv and only 57-SVE-07A has a PCE concentration above its noncancer hazard index value of 1.0 concentration of 22 ppmv. However, wells 57-SVE-07A and 57-MPMP-10 are not located near (within 100 feet) any buildings.

Well 57-SVE-06A (screened from 14 to 32 feet bgs) is located approximately 20 feet from Building 7022, which has occasional workers. This well contained PCE at 0.81 ppmv and TCE at 0.65 ppmv in the August 2014 samples. Because the screening levels represent a 1E-06 excess cancer risk, these concentrations would represent an approximate 3E-06 excess cancer risk, which is within the 1E-06 to 1E-04 risk management range. However, this well is used for extraction, which should mitigate any potential indoor air risk from vapor intrusion during system operation. Well 57-PW-02 (screened from 7 to 15 feet bgs) can be used to assess Building 7024, the other site building that has occasional workers. This well did not contain any VOCs above shallow soil vapor screening levels in the most recent sampling event, indicating no excessive indoor air risk.

SVE System Compliance. The Site SD-57 SVE system is in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs based on calculations from monthly compliance samples, and the ILCR was less than 1 in 1 million. Compliance monitoring results are reported in the annual SVE/BV reports (MWH, 2010l; URS, 2011c; 2012f; 2013f; 2014d).

Institutional Controls. ICs are in place and effective. Inspections were conducted to ensure that ICs are maintained and enforced in 2012, covering the period September 2010 through January 2012 (URS, 2012b); in 2012, covering all of 2012 (URS, 2013b); and in 2014, covering all of 2013 (AFCEC, 2014). Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. A building was demolished in 2011 that caused minimal surface disturbance, but no ICs were violated.

In November 2012, the parcel associated with Site SD-57 (Parcel A-1) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. Once the SLUC is executed, if the transferee fails to provide an annual compliance report to the state, then under CERCLA and the NCP, the Air Force is responsible for monitoring and reporting on the ICs in order to be in compliance with the terms of the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a) and to be protective of human health and the environment.

Progress Toward Meeting RAOs. During the last 5 years, the SVE system at Site SD-57 has made progress toward meeting the RAO of mitigating the residual source of vadose zone contamination that may pose an unacceptable threat to groundwater quality. Despite relatively low mass extraction rates at Site SD-57, a total of approximately 114 pounds of contaminants were estimated to have been removed during the last 5 years.

ICs have been implemented at Site SD-57 and are monitored annually to meet the RAOs of (1) preventing unacceptable human exposure to soil vapor or residual contamination, (2) protecting the integrity of the soil remedial actions and systems, including the associated monitoring systems, and (3) preserving access for the Air Force, EPA, and the State of California to the site, the remedial systems, and associated monitoring systems. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

7.4.3.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). During the period covered by this five-year review, there were changes in toxicity data (e.g., CCl_4, cis-1,2-DCE, PCE, and TCE), but they do not affect the protectiveness of the remedy and have not resulted in development of enforceable standards for soil vapor. ICs to prevent potential unacceptable exposure to VOCs from soil vapor inhalation are in place and effective, and the SVE system will operate until narrative soil cleanup levels for groundwater protection are achieved.

7.4.3.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.4.4 Site SD-59

7.4.4.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Soil OU and Groundwater OU ROD (AFBCA, 1996a), as modified by two ESDs (AFBCA, 1998b; AFRPA, 2010a). As discussed below, the original Site SD-59 VOC source area appears to have been remediated and another source area may exist.

Remedy Performance. In November 2008, the SVE system was shut down for replacement of the system’s air-water-separator pump and heat exchanger. The system remained offline through the end of 2008 but was brought back online early January 2009 once the air-water-separator pump and heat exchanger were replaced. The SVE system shut down again in mid-January 2009 because the motor and blower failed and was not restarted until late July 2009 after the motor and blower were replaced (MWH, 2010l). In late August 2009, the SVE system was shut down during installation of two soil vapor monitoring wells (59-PW-05 and 59-PW-06) at the eastern and southeastern margins of the site (Figure 4-10). The wells were expected to bound the extent of TCE contamination observed at soil vapor monitoring wells 59-MPMP-009 and 59-PW-03 (MWH, 2010l). However, the new wells had similar or greater TCE concentrations.

Although the SVE system was restarted in December 2009, pursuit of site closure was recommended because the decrease in mass removal indicated effective remediation of the vadose zone had become limited (MWH, 2010l). At the end of January 2010, the SVE system was shut down for rebound monitoring. However, the SVE system was restarted in mid-November 2010 to target contaminant mass removal along the eastern and southern margins of the site where elevated concentrations of chlorinated VOCs were detected in the soil vapor wells (URS, 2011c). SVE operations continued until the end of June 2011.

Because of low contaminant mass removal rates, 21 wells were sampled in September 2011 to evaluate the SVE system at Site SD-59 for either optimization or ceased operation (URS, 2012f). Of the 21 wells sampled, 18 wells had TCE or CCl_4 concentrations greater than GCLEs. The majority of wells with VOC concentrations greater than GCLEs were in the southeastern portion of the site, away from the former wash rack and OWS (the original VOC source areas) and SVE wells. To enhance contaminant removal from this area of the site, two wells (59-PW-05 and 59-PW-06; Figure 4-10), each with multiple screened intervals, were plumbed into the extraction system in February 2012 (URS, 2013f). In mid-March 2012, SVE resumed and operated from these two wells and 59-PW-03 until the system was shut down for rebound monitoring at the end of June 2012.

Fourteen samples from 10 of 21 wells sampled in 2012 had one or more contaminants at a concentration greater than the GCLE. However, nearly all soil vapor concentrations were lower in 2012 than in the previous samples, particularly at the recently operated and plumbed SVE wells (59-PW-03, 59-PW-05 and 59-PW-06), where TCE concentrations were reduced by orders of magnitude after only a few months of operation, with no rebound. This observation suggested little VOC mass is present in this area (URS, 2013f). Although Site SD-59 was recommended for closure because vadose zone modeling of the 2012 soil vapor data indicated an insignificant risk to groundwater, the SVE system was restarted in February 2013 to remove shallow residual TCE and operated until the end of July 2013. The SVE system remains shut down.

Because there was some concern that remaining soil vapor concentrations at SVE wells 59-PW-05 and 59-PW-06 were not defined to the east and south, two shallow soil vapor wells east (59-PW-07) and south (59-PW-08) of 59-PW-06 were installed in January 2014 (Figure 4-10). The wells were installed to show that TCE from Site SD-59 is adequately defined or to indicate whether another VOC source may exist south or east of the site. TCE was detected at 0.35 ppmv at 59-PW-08 and at 1.4 ppmv at 59-PW-07. While the 59-PW-08 result was considered confirmation of the southern extent of TCE, the eastern extent was still in question. Higher TCE concentrations at 59-PW-07 in April 2014 (2.3 ppmv) and October 2014 (4.9 ppmv) suggested TCE rebound may be occurring and that another TCE source area may be present, presumably associated with Building 4260, located approximately 100 feet north of 59-PW-07. Nested vapor wells 59-PW-09A (screened 10 to 11 feet bgs) and 59-PW-09B (screened 20 to 21 feet bgs) near Building 4260 were installed and sampled in November 2014; these wells contained TCE at 5.7 and 7 ppmv, respectively.

Data from the new wells suggest that the original Site SD-59 VOC source has been remediated but that another source area may exist near Building 4260, which is outside of the current IC boundary and will be further evaluated. Building 4260 is mostly a large, open, hangar-type structure that is likely well-ventilated, mitigating vapor intrusion issues. However, there are offices located along the south wall, closer to the new wells, and these more enclosed spaces are a potential concern. The recent shallow soil vapor sampling results exceed the calculated TCE commercial/industrial soil vapor screening level of 0.558 ppmv (calculated from California Department of Toxic Substances Control recommended industrial indoor air screening values [DTSC Office of Human and Environmental Risk, 2014] and attenuation factors [DTSC, 2011a]). However, assuming the screening values represent a 1E-06 cancer risk, the concentrations detected (maximum 7 ppmv) would represent a 1.25E-05 risk, which is well within the EPA risk management range of 1E-04 to 1E-06. This value also corresponds to a noncancer hazard index value of 4.7 (based on 1.5 ppmv TCE corresponding to a noncancer hazard index of 1.0). These concentrations suggest that additional investigation and assessment activities are necessary in this area. The IC boundary should be extended to the south and east to include this area.

SVE System Compliance. During the period of this five-year review, the Site SD-59 SVE system (when operating) was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs based on calculations from monthly compliance samples. Since March 2006, the Site SD-59 SVE system had been operating without air emission treatment due to low ROC emission rates; however, rather than risk an emission rate excursion when 59-PW-05 and 59-PW-06 were plumbed into the extraction system in February 2012, GAC treatment was added. In June 2013, an emissions risk analysis was completed, and the calculated cancer risks were less than levels requiring abatement. Therefore, the GAC was removed, and the system effluent discharged to the atmosphere without treatment. Compliance monitoring results are reported in the annual SVE/BV reports (MWH, 2010l; URS, 2011c; 2012f; 2013f; 2014d).

Institutional Controls. ICs are in place and effective. Inspections were conducted to ensure that ICs are maintained and enforced in 2012, covering the period September 2010 through January 2012 (URS, 2012b); in 2012, covering all of 2012 (URS, 2013b); and in 2014, covering all of 2013 (AFCEC, 2014). Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. With regulatory agency notification and approval, excavation and horizontal drilling were conducted to connect two existing soil vapor monitoring wells (59-PW-05 and 59-PW-06) to the remediation system for SVE operations.

In November 2012, the parcel (A-1) associated with Site SD-59 was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. Once the SLUC is executed, if the transferee fails to provide an annual compliance report to the state, then under CERCLA and the NCP, the Air Force is responsible for monitoring and reporting on the ICs in order to be in compliance with the terms of the 2010 Soil OU and Groundwater OU ESD (AFRPA, 2010a) and to be protective of human health and the environment.

As stated above, data from new wells installed in 2014 indicate that the IC boundary needs to be expanded to the east and south.

Progress Toward Meeting RAOs. During the last 5 years, the SVE system at Site SD-59 has made progress toward meeting the RAO of mitigating the residual source of vadose zone contamination that may pose an unacceptable threat to groundwater quality, and a closure report to document that no further treatment of the vadose zone is necessary at Site SD-59 was scheduled for preparation in 2014. A total of approximately 80 pounds of contaminants were estimated to have been removed during the last 5 years. As discussed above, the original Site SD-59 source appears to have been remediated; the most recent investigation activities appear to indicate a different VOC source area not associated with the original Site SD-59 source may exist. If so, this different source area may be identified as a new VOC site.

ICs have been implemented at Site SD-59 and are monitored annually to meet the RAOs of (1) preventing unacceptable human exposure to soil vapor or residual contamination, (2) protecting the integrity of the soil remedial actions and systems, including the associated monitoring systems, and (3) preserving access for the Air Force, EPA, and the State of California to the site, the remedial systems, and associated monitoring systems. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

7.4.4.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). During the period covered by this five-year review, there were changes in toxicity data (e.g., CCl_4, cis-1,2-DCE, PCE, and TCE), but they do not affect the protectiveness of the remedy and have not resulted in development of enforceable standards for soil vapor. ICs to prevent potential unacceptable exposure to VOCs from soil vapor inhalation are in place and effective, and the SVE system will operate until narrative soil cleanup levels for groundwater protection are achieved.

7.4.4.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy at Site SD-59 as originally defined. However, as described in Section 7.4.4.1, additional investigation activities in 2014 indicate a possible VOC source area near Building 4260, different from the Site SD-59 source and outside of the current IC boundary. Further investigation and assessment activities are recommended in this area. Also, the IC boundary should be extended to the south and east to include this area.

7.5 OU 4 (Landfill OU)

The remaining Landfill OU remedies address only Sites LF-03 and LF-04 where caps were constructed over these sites where disposal of waste occurred. The Landfill OU remedy requires groundwater monitoring, some of which for VOCs is satisfied as part of the Groundwater OU remedy for the Northeast Plume (see Section 7.3.3), and also requires landfill gas monitoring.

7.5.1 Site LF-03

7.5.1.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Landfill OU ROD (AFBCA, 1995a), as modified by the ESD (AFBCA, 1996b) and Memorandum of Post-ROD Changes (AFRPA, 2009a).

Remedy Performance. Quarterly inspections at Site LF-03 were performed during the period of this five-year review. Overall, the cap and drainage system were observed to be in good condition. In 2011 and 2012, weeds were observed, but drainage was not blocked and no erosion was noted (URS, 2012e; 2013d). Between 2010 and 2012, the secondary fence was cut and repaired several times (URS, 2011d; 2012e; 2013d). The secondary fence surrounds a larger area that encompasses both LF-03 and LF-04. Maintenance of this secondary fence is not a requirement of the ARARs or the post-closure plan, but repairs were made to discourage trespassing near the landfills. In 2011, the main sign for the landfill was defaced and subsequently cleaned (URS, 2012e), and in 2012, the sign on the access gate was bent and subsequently reshaped (URS, 2013d). In addition, stopcocks, valves, and sample ports damaged by wildlife or the sun were replaced as necessary.

In June 2013, an aerial survey of Site LF-03 was conducted in accordance with the post-closure landfill requirement for the completion of an aerial survey every 5 years (Montgomery Watson, 1996; MWH, 2010i). The purpose of the aerial survey was to measure elevation data across the landfill cap at Site LF-03. The elevation data were compared to elevation data from the 2008 survey to identify areas of settlement. Results of the 2013 survey indicate that no areas of the Site LF-03 landfill cap have any significant settlement of 0.5 foot or greater (URS, 2013c).

When comparing the 1999 and 2013 elevation data, subsidence was greater than 0.5 foot (0.6 foot maximum) in areas centrally located within the southern half of the landfill (URS, 2013c). Other locations with settlement (elevation decrease) greater than 0.5 foot (1.3 feet maximum) are within or adjacent to the drainage ditch running along the southern portion of the landfill cap. These occurrences of subsidence are outside of the cap and are not due to settling of the waste. The areas that indicate decreased elevations up to 0.5 feet have not had a noticeable impact on drainage, and no erosion was observed during quarterly inspections (MWH, 2010k; URS, 2011d; 2012e; 2013d; 2014c).

During future landfill inspections, care will be taken to monitor any areas of known settlement on the landfill cap to verify the cap is intact and drainage is maintained. Any observed areas of potential settlement, recommended corrective actions, and repair activities to correct settlement will be noted in the quarterly landfill inspection reports.

Landfill Gas Monitoring. During the period of this five-year review, post-closure gas monitoring indicates that little methane is being produced at LF-03. From 2009 through 2013, methane concentrations measured at the six gas migration probes with screen intervals that extend to the elevation of the bottom of the waste and the four passive gas vents did not exceed the compliance level of 5 percent by volume in air. VOC emissions from the gas vents were also monitored from 2009 through 2013, and all results were less than the 15 ppmv action level for VOCs that would trigger sampling for laboratory analysis. Compliance monitoring results are reported in the quarterly and annual post-closure landfill inspection and gas monitoring reports (MWH, 2010k; URS, 2011d; 2012e; 2013d; 2014c).

Through 2Q13, landfill gas monitoring (field measurements) was conducted quarterly at Site LF-03. Based on a history of low and compliant methane and VOC field measurements, the frequency of landfill gas monitoring at Site LF-03 has been reduced from quarterly to annually. Beginning in 2014, landfill gas monitoring will only be conducted during the first quarter at Site LF-03. Quarterly post-closure inspections will continue to be conducted.

Groundwater Monitoring. VOC monitoring near Site LF-03 satisfies the dual requirements for detection and corrective action monitoring for VOCs. A discussion regarding VOCs at Site LF-03 is presented in Section 7.3.3. Detection and evaluation monitoring as appropriate for non-VOCs is also part of the post-closure monitoring program at Site LF-03. Non-VOCs analyzed at Site LF-03 include metals, general minerals, and TPH.

Based on persistent detections of chromium and/or nickel exceeding upper background levels at MAFB-112, an evaluation monitoring program had been ongoing since 1Q06 at Site LF-03 for these two metals. The source of chromium and nickel in groundwater at MAFB-112 was thought to be corrosion of the stainless steel well screen and not a result of a release from the landfills. To evaluate this hypothesis, a monitoring well (MAFB-465) constructed with a polyvinyl chloride casing and screen was installed between Site LF-04 and MAFB-132 (a Site LF-04 well). Quarterly sample results from 4Q12 though 3Q13 supported the hypothesis that the metals are associated with corrosion of stainless steel screens, with nickel and chromium being detected at concentrations less than their upper background levels at MAFB-465, while VOCs were detected at similar concentrations to samples collected from MAFB-132. This indicates that the landfills are not the source of elevated nickel and chromium concentrations at

MAFB-112 (URS, 2014b), and the wells that comprised the evaluation monitoring program revert to detection monitoring for nickel and chromium starting in 2014. Manganese and vanadium also have been occasionally detected exceeding upper background concentrations at Site LF-03 wells between 2009 and 2013; however, concentrations were close to upper background concentrations and not indicative of a release from the landfill. No general minerals were detected at concentrations greater than calculated upper background concentrations during the period of this five-year review.

Institutional Controls. ICs are in place and effective. Inspections were conducted in 2010, covering the period August 2009 through August 2010 (AFRPA, 2010c); 2012, covering the period September 2010 through January 2012 (URS, 2012b); 2012, covering all of 2012 (URS, 2013b); and 2013, covering all of 2013 (AFCEC, 2014), to ensure that ICs are maintained and enforced. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. In 2010, Sacramento County decommissioned two shallow soil vapor monitoring wells installed in conjunction with a proposed sewer pipeline. In 2011, with the approval of the Air Force and regulatory agencies, including CalRecycle, an extension of Zinfandel Drive was constructed that passes through the IC area. The roadbed was determined not to provide a significant conduit for landfill gases. The perimeter security fences have remained intact and signs visible and in good condition, although repairs to the secondary fence (not required by an ARAR or IC) were made in 2010, 2011, and 2012 to discourage trespassing.

In November 2012, the two parcels (A-1 and A-3) associated with Site LF-03 were transferred from Air Force ownership, and the deed restriction language in the Memorandum of Post-ROD Changes (AFRPA, 2009a) was included in the deeds. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deeds. As of October 2014, a SLUC is in place for the parcel (A-3) containing Site LF-03 and another SLUC is in preparation for the parcel (A-1) containing part of the 1,000-foot buffer around Site LF-03. The SLUC requires or will require the new property owner to conduct annual IC inspections and to report on those inspections to the state until the ICs at the site are terminated. As of October 2014, the state had not received a compliance report from the new landowner, Sacramento County, due 1 February of each year. If the transferee fails to provide an annual compliance report to the state in accordance with an executed SLUC, then the Air Force is responsible for monitoring and reporting on the ICs. The Air Force has exercised this responsibility in accordance with CERCLA and the NCP by conducting annual inspections and preparing annual compliance reports. Therefore, human health and the environment have been protected in compliance with the terms of the Memorandum of Post-ROD Changes (AFRPA, 2009a).

Progress Toward Meeting RAOs. The post-closure maintenance of the landfill cap and landfill gas monitoring at Site LF-03 are meeting the RAO of compliance with ARARs established in the Landfill OU ROD, including portions of the CFR 40, Part 258, and the CCR Titles 14 and 23 (since recodified in Title 27). Because of the compliant methane and VOC field measurements, the frequency of landfill gas monitoring at Site WP-07 was reduced from quarterly to annually effective after 2Q13.

ICs have been implemented at Site LF-03 and are monitored annually to meet the RAOs of (1) preventing human exposure to methane in structures that may be built within 1,000 feet of Site LF-03, (2) protecting the integrity of the remedial system(s), including the associated monitoring system, and (3) protecting necessary access to the site and the remedial system(s), including the associated monitoring system. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

7.5.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see discussion in Section 7.4.1.2 and Table 7-2 regarding landfill ARARs). There have been no changes that affect the protectiveness of the remedy other than those described in the section on the Northeast Plume related to Site LF-03.

7.5.1.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.5.2 Site LF-04

7.5.2.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Landfill OU ROD (AFBCA, 1995a), as modified by the ESD (AFBCA, 1996b) and Memorandum of post-ROD Changes (AFRPA, 2009a).

Remedy Performance. Quarterly inspections at Site LF-04 were performed during the period of this five-year review. Overall, the cap and drainage system were observed to be in good condition. In 2011 and 2012, small rodent holes were observed but they did not extend to the cap liner; no corrective action was necessary (URS, 2012e; 2013d).

In 2010, one gate that is part of the primary security fence was noted as being off one of its two hinge pins (URS, 2011d). The gate was fixed, and site security was maintained as the gate continued to block access to the landfill. In 2010 and 2014, chains were added to secure two personnel gates in the security fence after the latches were no longer working effectively (URS, 2011d; AFCEC, 2014). During 1Q11 and 4Q11, the secondary fence at the end of Zinfandel Drive was found to be bent and broken and was subsequently repaired (URS, 2012e). As noted for Site LF-03, maintenance of this secondary fence is not a requirement of the ARARs or the post-closure plan, but repairs were made to discourage trespassing near the landfills. New locks were added to the two new gates installed following construction of the extension of Zinfandel Drive that bisects the existing access roads.

Construction debris and trash observed along the access road and fence were removed in 2013 (URS, 2014c). In addition, stopcocks, valves, and sample ports damaged by wildlife or the sun were replaced as necessary.

In 2012, minor ponding was observed near gas vent GV4-7 but no corrective action was necessary (URS, 2013d). During the 2013 IC inspections conducted in March 2014, minor ponding was observed on each of the three erosion control berms on the south side of the landfill cap (AFCEC, 2014). No evidence of erosion was visible, but additional fill material was added in May 2014 to prevent the pooling.

In June 2013, an aerial survey of Site LF-04 was conducted in accordance with the post-closure landfill requirement for the completion of an aerial survey every 5 years (Montgomery Watson, 1996; MWH, 2010i). The purpose of the aerial survey was to measure elevation data across the landfill cap at Site LF-04. The elevation data were compared to elevation data from the 2008 survey to identify areas of settlement. Results of the 2013 survey indicate settling has occurred at maximum depths of 0.8 foot in the southwestern portion of LF-04 based on a comparison of the elevation data between 2008 and 2013 (URS, 2013c). However, there are several areas of the southern portion of the capped area that have settled up to 0.5 feet since 2008. This settling is consistent with elevation decreases measured in the southern portion of the landfill since 1999. However, no erosion or drainage issues have been observed during the quarterly inspections performed since the previous topographic survey was conducted in 2008, and no repairs are warranted or planned at this time (URS, 2013c).

During future landfill inspections, care will be taken to monitor any areas of known settlement on the landfill cap to verify the cap is intact and drainage is maintained. Any observed areas of potential settlement, recommended corrective actions, and repair activities to correct settlement will be noted in the quarterly landfill inspection reports.

Landfill Gas Monitoring. During 1Q09, the fan system in GV4P-8 stopped operating, and methane was twice detected at a concentration greater than the methane compliance level (5 percent by volume in air) at gas migration probe MW-403 at 10.5 feet (MWH, 2010k). A laboratory sample was collected following the second exceedance of the methane compliance level, and the results confirmed the exceedance. The fan system was replaced in April 2009, and methane concentrations returned to compliant levels. A backup set of fans was made available should the fan system fail in the future. Weekly methane monitoring at GV4P-8 and MW-403 was implemented until mid-May 2009 when monitoring was reduced to quarterly.

At the beginning of 2010, weekly monitoring was conducted at GV4P-8 and MW-403 because inspections indicated that the solar fans often stopped operating during inclement weather (overcast/foggy/rainy) allowing methane concentrations to build up (MWH, 2010m). If the fans ceased operation, methane migration could occur toward MW-403 and allow methane concentrations to exceed the 5 percent compliance level. On 19 January 2010, the solar-powered fans were observed to be not operating, and field monitoring indicated that the methane concentration exceeded 50,000 ppmv (5 percent) at MW-403 at 10.5 feet. A laboratory sample was collected, and the result was 4.1 percent methane in air, which is less than the compliance limit. This event prompted conducting methane monitoring approximately twice per week for GV4P-8 and MW-403 from mid-January through the end of June 2010. The twice-weekly methane monitoring was then discontinued because of no further observations of high methane concentrations. However, weekly visual inspections to ensure that the solar fans were working were continued throughout the remainder of the review period (URS, 2011d; AFCEC, personal communication).

No exceedances of the methane compliance level were measured in 2011 (URS, 2012e). However, during 3Q12, the methane concentration exceeded the 5 percent compliance level at MW-17B at 9 feet. A confirmation vapor sample was collected for laboratory analysis, and methane was reported exceeding the compliance limit at 7.8 percent. Weekly monitoring ensued at MW-17B at 9 feet until the end of September 2012; methane concentrations did not again exceed 5 percent. MW-17B at 18.5 feet was also monitored weekly through the end of September and indicated no methane readings exceeding 5 percent (URS, 2013d). In 2013 and 2014, methane concentrations in all gas migration probes at Site LF-04 were less than the 5 percent methane compliance level (URS, 2014c). Because of the occasional exceedances of the 5 percent compliance concentration for methane, landfill gas monitoring frequency at Site LF-04 remains quarterly.

VOC emissions from the gas vents were also monitored from 2009 through 2014, and all results were less than the 15 ppmv action level for VOCs that would trigger sampling for laboratory analysis. Compliance monitoring results are reported in the quarterly and annual post-closure landfill inspection and gas monitoring reports (MWH, 2010k; URS, 2011d; 2012e; 2013d; 2014c).

Groundwater Monitoring. VOC monitoring near Site LF-04 satisfies the dual requirements for detection and corrective action monitoring for VOCs. A discussion regarding VOCs at Site LF-04 is presented in Section 7.3.3. Detection and evaluation monitoring as appropriate for non-VOCs is also part of the post-closure monitoring program at Site LF-04. Non-VOCs analyzed at Site LF-04 include metals, general minerals, and TPH.

Based on persistent detections of chromium and/or nickel exceeding upper background levels in wells MAFB-132 and MAFB-136, an evaluation monitoring program had been ongoing since 1Q06 at Site LF-04 for these two metals. The source of chromium and nickel in groundwater at MAFB-132 and MAFB-136 was thought to be corrosion of the stainless steel well screens and not a result of a release from the landfills. To evaluate this hypothesis, a monitoring well (MAFB-465) constructed with a polyvinyl chloride casing and screen was installed between Site LF-04 and MAFB-132. Quarterly sample results from 4Q12 though 3Q13 supported the hypothesis that the metals are associated with corrosion of stainless steel screens, with nickel and chromium being detected at concentrations less than their upper background levels in MAFB-465, while VOCs were detected at similar concentrations to samples collected from MAFB-132. This indicates that the landfills are not the source of elevated nickel and chromium concentrations in MAFB-132 and MAFB-136 (URS, 2014b), and the wells that comprised the evaluation monitoring program reverted to detection monitoring for nickel and chromium starting in 2014. Manganese and vanadium have also been occasionally detected exceeding upper background concentrations at Site LF-04 wells between 2009 and 2013; however, results were close to upper background concentrations and not indicative of a release from the landfill. No general minerals were detected at concentrations greater than calculated upper background concentrations during the period of this five-year review.

Institutional Controls. ICs are in place and effective. Inspections were conducted in 2010, covering the period August 2009 through August 2010 (AFRPA, 2010c); 2012, covering the period September 2010 through January 2012 (URS, 2012b); 2012, covering all of 2012 (URS, 2013b); and 2013, covering all of 2013 (AFCEC, 2014), to ensure that ICs are maintained and enforced. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. In 2011, with the approval of the Air Force and regulatory agencies, including CalRecycle, an extension of Zinfandel Drive was constructed that passes through the IC area. The roadbed was determined to not provide a significant conduit for landfill gases. With regulatory agency notification and approval, one groundwater monitoring well was installed to the west of LF-04 in October 2012. The perimeter security fences have remained intact, although repairs to the secondary fence (non-ARAR related) were made in 2011 and 2012 to discourage trespassing and one gate hinge on the primary security fence was repaired in 2010. Signs were visible and in good condition through 3Q14.

In November 2012, the parcel (A-3) associated with Site LF-04 was transferred from Air Force ownership, and the deed restriction language in the Memorandum of Post-ROD changes (AFRPA, 2009a) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. In June 2013, a SLUC was executed for this parcel; therefore, the new property owner is required to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. As of October 2014, the state had not received a compliance report from the new landowner, Sacramento County, due 1 February of each year. If the transferee fails to provide an annual compliance report to the state in accordance with an executed SLUC, then the Air Force is responsible for monitoring and reporting on the ICs. The Air Force has exercised this responsibility in accordance with CERCLA and the NCP by conducting annual inspections and preparing annual compliance reports. Therefore, human health and the environment have been protected in compliance with the terms of the Memorandum of Post-ROD Changes (AFRPA, 2009a).

Progress Toward Meeting RAOs. The post-closure maintenance of the landfill cap and landfill gas monitoring at Site LF-04 are generally meeting the RAO of compliance with ARARs established in the Landfill OU ROD, including portions of CFR 40, Part 258, and CCR Titles 14 and 23 (since recodified in

Title 27). Quarterly landfill inspections revealed no major issues; however, occasional exceedances of the 5 percent compliance concentration for methane have occurred. To address the exceedances at gas migration probe MW-403, where the compliance level has been exceeded more than once, a set of exhaust fans was installed at passive gas trench vent GV4P-8 in 2007 (prior to the period of this five-year review). Since installation of the exhaust fans, methane concentrations have been less than the compliance level at MW-403 when the fans are operating. After fan failures in 2009 and 2010, the fans were monitored routinely through the rest of the review period to maintain their operation.

ICs have been implemented at Site LF-04 and are monitored annually to meet the RAOs of (1) preventing human exposure to methane in structures that may be built within 1,000 feet of Site LF-04, (2) protecting the integrity of the remedial system(s), including the associated monitoring system, and (3) protecting necessary access to the site and the remedial system(s), including the associated monitoring system. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

7.5.2.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see discussion in Section 7.4.1.2 and Table 7-2 regarding landfill ARARs). There have been no changes that affect the protectiveness of the remedy other than those described in the section on the Northeast Plume related to Site LF-03. In addition, of the affected ARARs, those solely governing the operation of Site LF-04 while it was accepting waste consolidated from other sites are no longer applicable to the site because the site is now closed.

7.5.2.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.6 OU 5 (Basewide OU)

7.6.1 Site FT-10C/ST-68

7.6.1.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Basewide OU ROD (AFBCA, 1998c), as modified by two ESDs (AFRPA, 2008b; 2010b).

Remedy Performance. The Site FT-10C/ST-68 SVE/BV system was permanently shut down in August 2008 and did not operate during the period of this five-year review. A report to demonstrate that the vadose zone at Site FT-10C/ST-68 had been remediated and did not pose a future unacceptable threat to groundwater was prepared (MWH, 2010a), and concurrence with these conclusions was received from the regulatory agencies (CVWB, 2011; DTSC, 2011b; EPA, 2012c). The evaluation presented in the report led to the conclusion that continued in situ remediation was not necessary and that closure of the vadose zone portion of the active remedy (i.e., SVE/BV) was appropriate (MWH, 2010a). However, continued implementation of the ICs established in the Basewide OU ESD (AFRPA, 2010b) is necessary to prevent potential exposure to contaminants in indoor air in any new buildings.

The SVE/BV system and components were decommissioned in 2012 (ADVENT Environmental, Inc., 2012). Each well was overdrilled to 5 feet bgs, with the exception of one well next to a building that could not be overdrilled. Each well was then grouted and the sealing material was allowed to spill over into the excavation, forming a cap. After the sealing material had set, the excavation was filled with compacted native soil or other appropriate fill material. Any other feature associated with the well (e.g., well box or vault) was removed, and the surface finished to match the surrounding area. All underground piping was left in place and capped below the ground surface. All aboveground piping was removed and disposed of as construction debris.

Soil Excavation. Prior to this fourth five-year review period, in November and December 2008, the lead-contaminated ashy debris and soil discovered in 2002 beneath and north of Truemper Way was excavated and disposed as a non-Resource Conservation and Recovery Act hazardous waste at Buttonwillow Landfill in Buttonwillow, California, a CERCLA-certified Class I Landfill Facility (MWH, 2009b). Approximately 140 cy of soil were removed from Site FT-10C/ST-68. The soil was excavated such that ICs related to residual lead will not be required (i.e., residual lead concentrations met the 151 mg/kg unrestricted use level designated in the ESD).

Institutional Controls. ICs are in place and effective. Inspections were conducted to ensure that ICs are maintained and enforced in 2012, covering the period September 2010 through January 2012 (URS, 2012b); in 2012, covering all of 2012 (URS, 2013b); and in 2014, covering all of 2013 (AFCEC, 2014). Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

In November 2012, the parcel associated with Site FT-10C/ST-68 (Parcel A-1) was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010b) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. Once the SLUC is executed, if the transferee fails to provide an annual compliance report to the state, then under CERCLA and the NCP, the Air Force is responsible for monitoring and reporting on the ICs in order to be in compliance with the terms of the 2010 Basewide OU ESD (AFRPA, 2010b) and to be protective of human health and the environment.

Progress Toward Meeting RAOs. The SVE/BV system at Site FT-10C/ST-68 achieved the RAO of mitigating the residual source of vadose zone contamination that posed an unacceptable threat to groundwater quality. Consequently, the vadose zone portion of the Site FT-10C/ST-68 active remedy (i.e., SVE/BV) was closed, and the SVE/BV system was decommissioned. In addition, lead-contaminated soil has been removed to a level consistent with unrestricted use.

ICs have been implemented at Site FT-10C/ST-68 and are monitored annually to meet the RAOs of (1) preventing unacceptable human exposure to soil vapor or residual contamination, (2) protecting the integrity of the remedial systems, including the associated monitoring system, and (3) preserving necessary access to the remedial system, and associated monitoring system. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. The Site FT-10C/ST-68 SVE/BV system and components have been decommissioned; therefore, the ICs related to protection of those components no longer apply.

7.6.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). During the period covered by this five-year review, there were changes in toxicity data (e.g., CCl_4, cis-1,2-DCE, PCE, and TCE), but the changes do not affect the protectiveness of the remedy and have not resulted in development of enforceable standards for soil vapor. ICs to prevent potential unacceptable exposure to VOCs from soil vapor inhalation are in place and effective, and

SVE/BV operated until narrative soil cleanup levels for groundwater protection were achieved as documented in the *Site 10C/68 Closure Report* (MWH, 2010a).

The cleanup levels for lead in soil at Site FT-10C/ST-68 is 800 mg/kg (15 mg/L soluble). This concentration is health-protective under commercial/industrial or recreational land use scenarios but not under the unrestricted use scenario. At Site FT-10C/ST-68, excavation was anticipated to also meet the unlimited use and unrestricted exposure threshold of concern of 151 mg/kg established through site-specific determinations using DTSC's LEADSPREAD model and documented in the 2008 ESD for Site FT-10C/ST-68 (AFRPA, 2008b). Following excavation, the maximum lead concentration remaining in soil at Site FT-10C/ST-68 was 127 mg/kg with an average concentration of 44 mg/kg and a median concentration of 19 mg/kg. These concentrations are less than 151 mg/kg, and all soluble lead concentrations were less than 15 mg/L (MWH, 2009b). Therefore, ICs related to lead contamination are not required at Site FT-10C/ST-68. The 151 mg/kg is less than EPA's 400 mg/kg residential RSL for lead.

In 2009, OEHHA developed revised industrial and residential CHHSLs for lead. The residential CHHSL for lead in soil is 80 mg/kg, and the industrial CHHSL for lead in soil is 320 mg/kg (OEHHA, 2009). In 2007, OEHHA also developed "a new toxicity evaluation of lead, which replaces the 10 μg/dl threshold blood lead concentration with a source-specific 'benchmark change' of 1 μg/dl" (DTSC, 2014).

It is the Air Force's position that CHHSLs are not promulgated standards, are not enforceable, and are not ARARs for Site FT-10C/ST-68. The residential CHHSL is less than the 151 mg/kg threshold of concern compatible with unrestricted use established in the 2008 ESD for Site FT-10C/ST-68 (AFRPA, 2008b). The 151 mg/kg unrestricted use level established in the 2008 ESD is health-protective, and ICs are not needed at Site FT-10C/ST-68. Consequently, no new standards have been promulgated or proposed since remedy selection that would call into question the protectiveness of the remedy for soil at Site FT-10C/ST-68.

For completeness, a 95th UCL about the mean was calculated for lead concentrations remaining at the site (Appendix D). For Site FT-10C/ST-68, results indicate that the 95th UCL is 101.1 mg/kg. Inputting this result into the updated DTSC LEADSPREAD model yields a 90th percentile estimate of increase of blood lead in a child of 1.3 μg/dl.

7.6.1.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.6.2 Site LF-18

7.6.2.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Basewide OU ROD (AFBCA, 1998c), as modified by the 2010 Basewide OU ESD (AFRPA, 2010b).

Remedy Performance. In November 2008, treatment of vapors from Site LF-18 ceased, and no SVE was conducted at this site during the period of this five-year review. A report to demonstrate that the vadose zone at Site LF-18 (including Subsite OT-23A) had been remediated and did not pose a future unacceptable threat to groundwater was prepared (MWH, 2010b), and concurrence with these conclusions was received from the regulatory agencies (CVWB, 2011; EPA, 2012d). The evaluation presented in the report led to the conclusion that continued in situ remediation was not necessary and that closure of the vadose zone portion of the active remedy (i.e., SVE) was appropriate (MWH, 2010b). However, continued implementation of the ICs established in the 2010 Basewide OU ESD (AFRPA, 2010b) is necessary to prevent potential exposure to contaminants in indoor air in any new buildings.

The aboveground piping manifold and well components were decommissioned in 2012 (ADVENT Environmental, Inc., 2012). (Note: Vapor extracted from Site LF-18 wells was treated by the Site SD-59 SVE system, which was not decommissioned because SVE continued at that site.) Each well was overdrilled to 5 feet bgs. Each well was then grouted and the sealing material was allowed to spill over into the excavation, forming a cap. After the sealing material had set, the excavation was filled with compacted native soil or other appropriate fill material. Any other feature associated with the well (e.g., well box or vault) was removed, and the surface finished to match the surrounding area. All aboveground piping was removed and disposed of as construction debris.

Institutional Controls. ICs are in place and effective. Inspections were conducted in 2012, covering the period September 2010 through January 2012 (URS, 2012b); 2012, covering all of 2012 (URS, 2013b); and 2014, covering all of 2013 (AFCEC, 2014), to ensure that ICs are maintained and enforced. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

In November 2012, the parcel (A-1) associated with Site LF-18 was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010b) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. Once the SLUC is executed, if the transferee fails to provide an annual compliance report to the state, then under CERCLA and the NCP, the Air Force is responsible for monitoring and reporting on the ICs in order to be in compliance with the terms of the 2010 Basewide OU ESD (AFRPA, 2010b) and to be protective of human health and the environment.

Progress Toward Meeting RAOs. At Site LF-18, the RAO of mitigating the residual source of vadose zone contamination that posed an unacceptable threat to groundwater quality has been achieved. Consequently, the vadose zone portion of the Site LF-18 active remedy (i.e., SVE) was closed, and the SVE piping and wells were decommissioned.

ICs have been implemented at Site LF-18 and are monitored annually to meet the RAOs of (1) preventing unacceptable human exposure to soil vapor or residual contamination, (2) protecting the integrity of the remedial systems, including the associated monitoring system, and (3) preserving necessary access to the remedial system, and associated monitoring system. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections. The Site LF-18 SVE piping and wells have been decommissioned; therefore, the ICs related to protection of those components no longer apply.

7.6.2.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). During the period covered by this five-year review, there were changes in toxicity data (e.g., CCl_4, cis-1,2-DCE, PCE, and TCE), but the changes do not affect the protectiveness of the remedy and have not resulted in development of enforceable standards for soil vapor. ICs to prevent potential unacceptable exposure to VOCs from soil vapor inhalation are in place and effective, and SVE operated until narrative soil cleanup levels for groundwater protection were achieved as documented in the *Site 18 and 23A Closure Report* (MWH, 2010b).

7.6.2.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.6.3 Site OT-23C

7.6.3.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Basewide OU ROD (AFBCA, 1998c), as modified by the 2010 Basewide OU ESD (AFRPA, 2010b).

Remedy Performance. During 2009, the SVE system at Site OT-23C operated from the beginning of January until the beginning of April, when it was shut down for a brief rebound period and reconfiguration of the operating well field (MWH, 2010l). The system then operated from mid-April 2009 until late May when it was shut down for a more extended rebound period. PCE concentrations continued to persist at all depths from the vadose zone for the portion of the site nearest the former dry cleaning facility; therefore, the SVE system was restarted in mid-July 2009 and operated until late July 2010 when it was shut down for rebound monitoring.

In 2010, 19 soil vapor samples were collected, and 13 of those samples had one or more contaminants (PCE and TCE only) at concentrations greater than the GCLE. All 13 samples were from SVE well 23-PW-01 and monitoring well 23-MP-008, at depths ranging from 9 to 77 feet bgs. These wells are within 5 to 10 feet of each other in the main vadose zone VOC source area, the portion of the site nearest the former dry cleaning facility (Figure 4-15). When the SVE system was restarted in mid-November 2010, extraction occurred from 23-PW-01(all four screened intervals) only (URS, 2011c).

At the end of June 2011, the SVE system was shut down and remained offline for the rest of the year. Fourteen of 18 samples collected in 2011 had one or more contaminants (PCE and TCE only) at a concentration greater than the GCLE. Concentrations were less than but similar to those from samples collected in 2010 with the highest concentrations at the same two wells (23-PW-01 and 23-MP-008) (URS, 2012f). Extraction at 23-PW-01 (all four screened intervals) resumed in January 2012.

Similar to 2011 operations, the SVE system operated from January until the end of June in 2012. Contaminant mass removal rates were slightly higher in 2012 than in 2011, even though extraction occurred at only 23-PW-01 in both years (URS, 2013f). Soil vapor samples were collected in October 2012, and PCE and/or TCE were detected at concentrations greater than the GCLEs in all six samples collected. Again, the highest concentrations reported in 2012 were at 23-PW-01 and 23-MP-008. Extraction at 23-PW-01 (all four screened intervals) and 23-SVED-001 (one screened interval) resumed in January 2013 and operated throughout the year, except from late July to mid-August 2013 when the system shut down for an unknown reason and no alarms were triggered and for a three-day period in October when there was a power outage. Flows were maximized at two depth intervals at 23-PW-01 (26 to 36 and 50 to 60 feet bgs) in November 2013. These two depths are on the top and bottom of a clay layer believed to contain PCE; the PCE removal rate appears to be limited by the relatively low diffusion rate from the clay matrix (URS, 2014d).

Samples were collected while the system was operating in June 2013, and PCE was detected at a concentration greater than its GCLE in six of eight samples collected. As of October 2014, focused SVE at 23-PW-01 (all four screened intervals) and 23-SVED-001 (one screened interval) continues, and further optimization of the SVE system is being assessed.

SVE System Compliance. During the period of this five-year review, the Site OT-23C SVE system (when operating) was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD), with the exception described below. Air emissions did not exceed 10 lbs/day for total ROCs or 0.79 lb/day for PCE based on calculations from monthly compliance samples, with one exception in December 2013. The PCE emission calculated for the sample collected in December 2013 was 1.74 lbs/day. Change-out of the GAC (two 3,000-pound vessels in series) used for air contaminant emissions abatement was completed on 23 December 2013 within two weeks of the collection of the non-compliant sample. Compliance monitoring results are reported in the annual SVE/BV reports (MWH, 2010l; URS, 2011c; 2012f; 2013f; 2014d).

Institutional Controls. ICs are in place and effective. Inspections were conducted in 2012, covering the period September 2010 through January 2012 (URS 2012b); 2012, covering all of 2012 (URS, 2013b); and 2013, covering all of 2013 (AFCEC, 2014), to ensure that ICs are maintained and enforced. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

In January 2013, the remaining parcel (P-2) associated with Site OT-23C was transferred from Air Force ownership, and the deed restriction language in the 2010 ESD (AFRPA, 2010b) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. In May 2013, a SLUC was executed for this parcel; therefore, the new property owner is required to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. If the transferee fails to provide an annual compliance report to the state in accordance with the executed SLUC, then the Air Force is responsible for monitoring and reporting on the ICs. The Air Force has exercised this responsibility in accordance with CERCLA and the NCP by conducting annual inspections and preparing annual compliance reports. Therefore, human health and the environment have been protected in compliance with the terms of the 2010 Basewide OU ESD (AFRPA, 2010b).

Progress Toward Meeting RAOs. During the last 5 years, the Site OT-23C SVE system has made progress toward meeting the RAO of mitigating the residual source of vadose zone contamination that may pose an unacceptable threat to groundwater quality. A total of approximately 1,430 pounds of contaminants are estimated to have been removed during the last 5 years, of which PCE accounted for approximately 1,395 pounds of the total.

As presented in the *2013 Soil Vapor Extraction/Bioventing Annual Monitoring Report* (URS, 2014d), average initial or baseline PCE concentrations were compared to the most recent sample concentrations. Initial PCE concentrations from the 61 site wells from which more than one sample was collected averaged 39.7 ppmv; the average PCE concentration for all of the most recent samples from those same wells is 5.1 ppmv. If the four samples from each of the two current hot spots (23-PW-01 and 23-MP-008) are removed, the difference between the average initial and average most recent PCE concentration for the remaining 53 site wells is less, decreasing from 31.7 to 0.17 ppmv.

After a first year average PCE extraction rate of 15.4 lbs/day (April 2000 to March 2001), annual PCE average daily extraction rates have averaged 1.14 lbs/day, fluctuating between 0.45 lb/day (2004-2005) and 2.1 lbs/day (2009-2010), with a standard deviation of 0.49 lb/day. The 891 pounds of PCE (of 2,493 pounds of contaminants) extracted the first year (2000-2001) decreased to an average of 233 pounds (of 277 pounds of contaminants) throughout the next 12 years.

A more typical SVE scenario would show a similar rapid decrease in concentrations followed by removal rates rapidly and asymptotically approaching zero. The steady rate of PCE removal at Site OT-23C is not typical. The suspected reason for the continued relatively high PCE removal rates is the presence of significant PCE mass near wells 23-PW-01 and 23-MP-008 in a relatively continuous clay layer extending from approximately 35 to 55 feet bgs beneath the site. If so, PCE may not be diffusing from this layer at a rate high enough for SVE to significantly reduce the remaining mass. However, the decrease in PCE groundwater concentrations beneath the site, from mostly 100 to 1,000 µg/L (maximum of 1,900 µg/L) in 2001 and 2002 to all less than the ACL of 5.0 µg/L by 2007, implies that SVE has been successful. Furthermore, the diffusion rate from the clay layer may not be enough to significantly impact groundwater. Focused SVE was continuing as of October 2014 at 23-PW-01 and 23-SVED-001 while the site is assessed. Vadose zone modeling may be necessary to assess whether residual PCE mass will impact groundwater if SVE is terminated. If so, enhancements/modifications to the SVE remedy (e.g., fracturing or thermal technologies) that are capable of expediting cleanup of residual contamination adsorbed to fine-grained soils may be evaluated.

Land-use restrictions were imposed as a condition of early transfer for most of the land associated with Site OT-23C; the remaining parcel (P-2) transferred after ICs were added to the remedy is on the margin of the site and the ICs are only necessary there to protect one monitoring well. The ICs have been implemented at Site OT-23C and are monitored annually to meet the RAOs of (1) protecting the integrity of the remedial systems, including the associated monitoring systems and (2) preserving necessary access to the remedial system, and associated monitoring systems. Through 2013, no deficiencies or inconsistent land uses were observed during the ICs inspections.

7.6.3.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). During the period covered by this five-year review, there were changes in toxicity data (e.g., CCl_4, cis-1,2-DCE, PCE, and TCE), but they do not affect the protectiveness of the remedy and have not resulted in development of enforceable standards for soil vapor. The SVE system will operate until narrative soil cleanup levels for groundwater protection are achieved.

7.6.3.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.6.4 Site OT-87

7.6.4.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Basewide OU ROD (AFBCA, 1998c), as modified by the 2010 Basewide OU ESD (AFRPA, 2010b).

Small Mammal Monitoring. During the period of this five-year review, the small mammal monitoring requirement of the Basewide OU ROD to ensure that residual concentrations of lead left in place at Site OT-87 do not pose a hazard to small mammals was completed. Monitoring was conducted between 2007 and 2009. No small mammals were trapped during attempts at Site OT-87 in 2007. In 2008, eight small mammals, including seven mice and one vole, were trapped (MWH, 2009e). In 2009, 28 small mammals, including 3 mice and 25 voles, were trapped. Fourteen of the voles were released (MWH, 2010c).

Lead concentrations were detected in the liver and kidney tissues of all small mammals captured from Site OT-87 in 2008 and 2009 (MWH, 2010c). A comparison of those concentrations with potentially toxic lead concentrations in small mammal organs reported in the literature suggests that the measured concentrations of lead in the samples collected from Site OT-87 are within background levels and generally regarded as no adverse effect levels (MWH, 2010c). Thus, there was no evidence from the 2008 or 2009 monitoring event to suggest that small mammals at Site OT-87 are accumulating lead in their tissues at concentrations greater than background levels (MWH, 2010c). Therefore, the Air Force concluded that residual lead concentrations in soil do not indicate the potential for adverse effects on small mammal populations and discontinued small mammal monitoring at Site OT-87 (MWH, 2010c). However, DTSC and the California Department of Fish and Wildlife (formerly California Department of Fish and Game) disagreed with this conclusion.

The Basewide OU ROD also requires regulatory agency notification if any dead waterfowl are found in the area of Site OT-87, and if any are found, they must be necropsied by a certified laboratory for signs of lead toxicity. Through September 2014, no dead waterfowl have been observed at Site OT-87.

Institutional Controls. ICs are in place and effective. Inspections were conducted in 2012, covering the period September 2010 through January 2012 (URS, 2012b); 2012, covering all of 2012 (URS, 2013b); and 2013, covering all of 2013 (AFCEC, 2014), to ensure that ICs are maintained and enforced. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

Use restrictions were implemented during the review period through Air Force ownership of the land, and through the terms of the lease to Sacramento County for use of the land as a regional park. When the ownership of the property is transferred to the county from the DOI, the ICs will be incorporated in the deed or other transactional documents. However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer.

Progress Toward Meeting RAOs. Although no specific RAOs are identified in the Basewide OU ROD for Site OT-87, the basis for cleanup is protection of human health and the environment. Prior to the period of this five-year review, lead-contaminated soil was excavated in accordance with the Basewide OU ROD remedy; however, concentrations of lead left in place are not compatible with unrestricted use of the site. Therefore, ICs to prohibit residential-type development and to prohibit disturbance of soil that may contain elevated lead concentrations until and unless it is demonstrated that lead concentrations in the soil at the site are no longer a threat to human health and the environment and without first obtaining written approval from the ROD signatories have been implemented and are monitored annually to meet the RAO of preventing unacceptable human exposure to residual lead contamination at Site OT-87. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

The small mammal monitoring requirement of the Basewide OU ROD was completed, and results through 2009 indicated that residual lead contamination at Site OT-87 does not pose a potential risk to small mammals (MWH, 2010c). Consequently, small mammal monitoring was discontinued at Site OT-87. In addition, no dead waterfowl have been observed at the site.

7.6.4.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes. There have been no changes that affect the protectiveness of the remedy.

In 2009, OEHHA developed revised industrial and residential CHHSLs for lead. The residential CHHSL for lead in soil is 80 mg/kg, and the industrial CHHSL for lead in soil is 320 mg/kg (OEHHA, 2009).

For completeness, a 95th UCL about the mean was calculated for lead concentrations remaining at the site (Appendix D). For Site OT-87, results indicate the following: Inside the IC area, the 95th UCL is 256.7 mg/kg, which is less than the industrial CHHSL of 320 mg/kg. Outside the IC area, the 95th UCL is

41.1 mg/kg, which is less than the residential CHHSL of 80 mg/kg." Inputting the 95th UCL results into OEHHA's updated LEADSPREAD model, the 90th percentile estimates of increase of blood lead level for a child are 3.3 μg/dl inside the IC area, and 0.5 μg/dl outside the IC area.

It is the Air Force's position that CHHSLs are not promulgated standards, are not enforceable, and are not ARARs for Site OT-87. Consequently, no new standards have been promulgated or proposed since remedy selection that would call into question the protectiveness of the remedy for soil at Site OT-87.

7.6.4.3 Question C. Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

7.7 OU 6 (Supplemental Basewide OU)

7.7.1 Site OT-89

7.7.1.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Supplemental Basewide OU ROD (AFRPA, 2006).

Institutional Controls. ICs are in place and effective. Inspections were conducted in 2010, covering the period September 2006 through August 2010 (AFRPA, 2010c); 2012, covering the period September 2010 through January 2012 (URS, 2012b); 2012, covering all of 2012 (URS, 2013b); and 2014, covering all of 2013 (AFCEC, 2014), to ensure that ICs are maintained and enforced. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

In November 2012, the parcel (A-1) associated with Site OT-89 was transferred from Air Force ownership, and the deed restriction language in the Supplemental Basewide OU ROD (AFRPA, 2006) was included in the deed. However, language requiring the new property owner to conduct annual inspections and to report on those inspections was not included in the deed. As of October 2014, a SLUC was in preparation for this parcel that will require the new property owner to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated. Once the SLUC is executed, if the transferee fails to provide an annual compliance report to the state, then under CERCLA and the NCP, the Air Force is responsible for monitoring and reporting on the ICs in order to be in compliance with the terms of the Supplemental Basewide OU ROD (AFRPA, 2006) and to be protective of human health and the environment.

Progress Toward Meeting RAOs. The RAOs identified in the Supplemental Basewide OU ROD for Site OT-89 are to: (1) prevent human exposure to lead concentrations greater than 192 mg/kg; (2) prevent plant exposure to lead concentrations greater than 700 mg/kg; and (3) prevent disturbance of subsurface soil that could threaten water quality. Prior to the period of this five-year review, contaminated soil was excavated as part of a time-critical removal action for Site OT-89; however, the concentrations of buried lead left in place are not known to be compatible with unrestricted use of the site. Therefore, ICs have been implemented at Site OT-89 and are monitored annually to meet the RAO of preventing unacceptable human exposure to residual lead contamination. Through 2013, no deficiencies or inconsistent land uses were observed during the IC inspections.

7.7.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes. There have been no changes that affect the protectiveness of the remedy.

The cleanup level for lead in soil at Site OT-89 is 192 mg/kg. This concentration is health-protective under commercial/industrial or recreational land use scenarios but not under the unrestricted use scenario. Consequently, ICs are in place as a part of the remedy for Site OT-89.

In 2009, OEHHA developed revised industrial and residential CHHSLs for lead. The residential CHHSL for lead in soil is 80 mg/kg, and the industrial CHHSL for lead in soil is 320 mg/kg (OEHHA, 2009).

For completeness, a 95th UCL about the mean was calculated for lead concentrations remaining at the site (Appendix D). For Site OT-89, results indicate the following: Inside the IC area, a 95th UCL could not be calculated because too few sample results are available. Most of the lead within the IC area is buried, and the ICs prevent exposure. (The maximum concentration that was detected in samples from this area is 16.3 mg/kg.) Outside the IC area, the 95th UCL for the area north of the IC area is 57.27 mg/kg, and the 95th UCL for the area south of the IC area is 72.36 mg/kg. Both of these concentrations are less than the residential CHHSL of 80 mg/kg. Inputting the 95th UCL results into OEHHA's updated LEADSPREAD model, the 90th percentile estimates of increase in blood lead level for a child are 0.7 µg/dl outside the IC area (north) and 0.9 µg/dl outside the IC area (south).

It is the Air Force's position that CHHSLs are not promulgated standards, are not enforceable, and are not ARARs for Site OT-89. Consequently, no new standards have been promulgated or proposed since remedy selection that would call into question the protectiveness of the remedy for soil at Site OT-89.

7.7.1.3 Question C. Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

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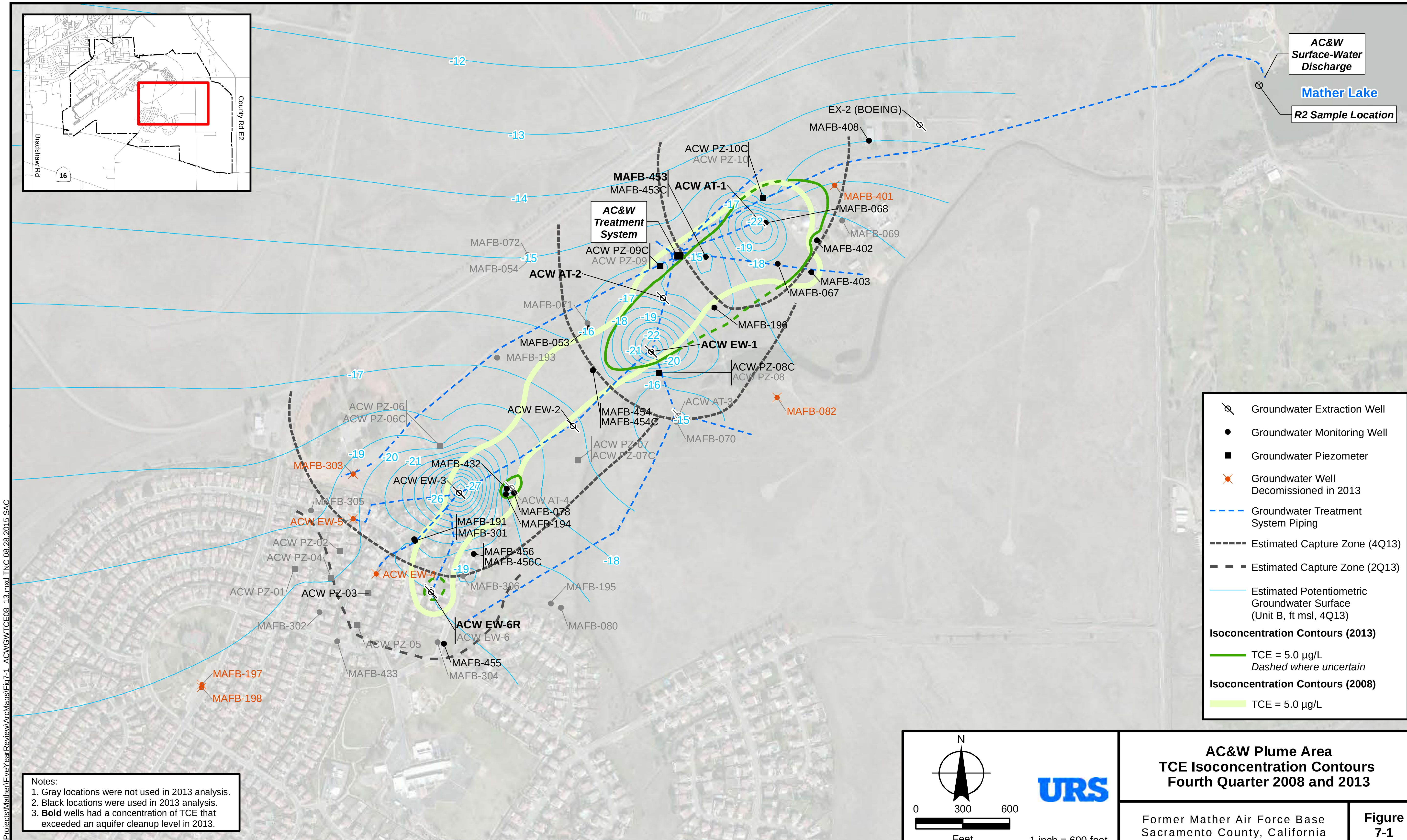
AC&W Surface-Water Discharge
Mather Lake
R2 Sample Location
AC&W Treatment System
EX-2 (BOEING)
MAFB-408
ACW PZ-10C
ACW PZ-10
MAFB-453
MAFB-453C
ACW AT-1
MAFB-401
MAFB-068
MAFB-069
MAFB-402
MAFB-403
MAFB-067
MAFB-072
MAFB-054
ACW PZ-09C
ACW PZ-09
ACW AT-2
MAFB-071
MAFB-196
MAFB-053
MAFB-193
ACW EW-1
ACW PZ-08C
ACW PZ-08
MAFB-082
ACW AT-3
MAFB-070
ACW PZ-06
ACW PZ-06C
ACW EW-2
MAFB-454
MAFB-454C
ACW PZ-07
ACW PZ-07C
MAFB-303
MAFB-432
ACW EW-3
ACW AT-4
MAFB-078
MAFB-194
MAFB-305
ACW EW-5
MAFB-191
MAFB-301
ACW PZ-02
ACW PZ-04
MAFB-456
MAFB-456C
ACW EW-4
MAFB-306
MAFB-195
ACW PZ-01
ACW PZ-03
MAFB-302
ACW EW-6R
ACW EW-6
MAFB-080
ACW PZ-05
MAFB-455
MAFB-304
MAFB-433
MAFB-197
MAFB-198
Bradshaw Rd
County Rd E2
16
Groundwater Extraction Well
Groundwater Monitoring Well
Groundwater Piezometer
Groundwater Well Decommissioned in 2013
Groundwater Treatment System Piping
Estimated Capture Zone (4Q13)
Estimated Capture Zone (2Q13)
Estimated Potentiometric Groundwater Surface (Unit B, ft msl, 4Q13)
Isoconcentration Contours (2013)
TCE = 5.0 µg/L
Dashed where uncertain
Isoconcentration Contours (2008)
TCE = 5.0 µg/L
Notes:
1. Gray locations were not used in 2013 analysis.
2. Black locations were used in 2013 analysis.
3. Bold wells had a concentration of TCE that exceeded an aquifer cleanup level in 2013.
N
0 300 600
Feet
1 inch = 600 feet
URS
AC&W Plume Area
TCE Isoconcentration Contours
Fourth Quarter 2008 and 2013
Former Mather Air Force Base
Sacramento County, California
Figure 7-1
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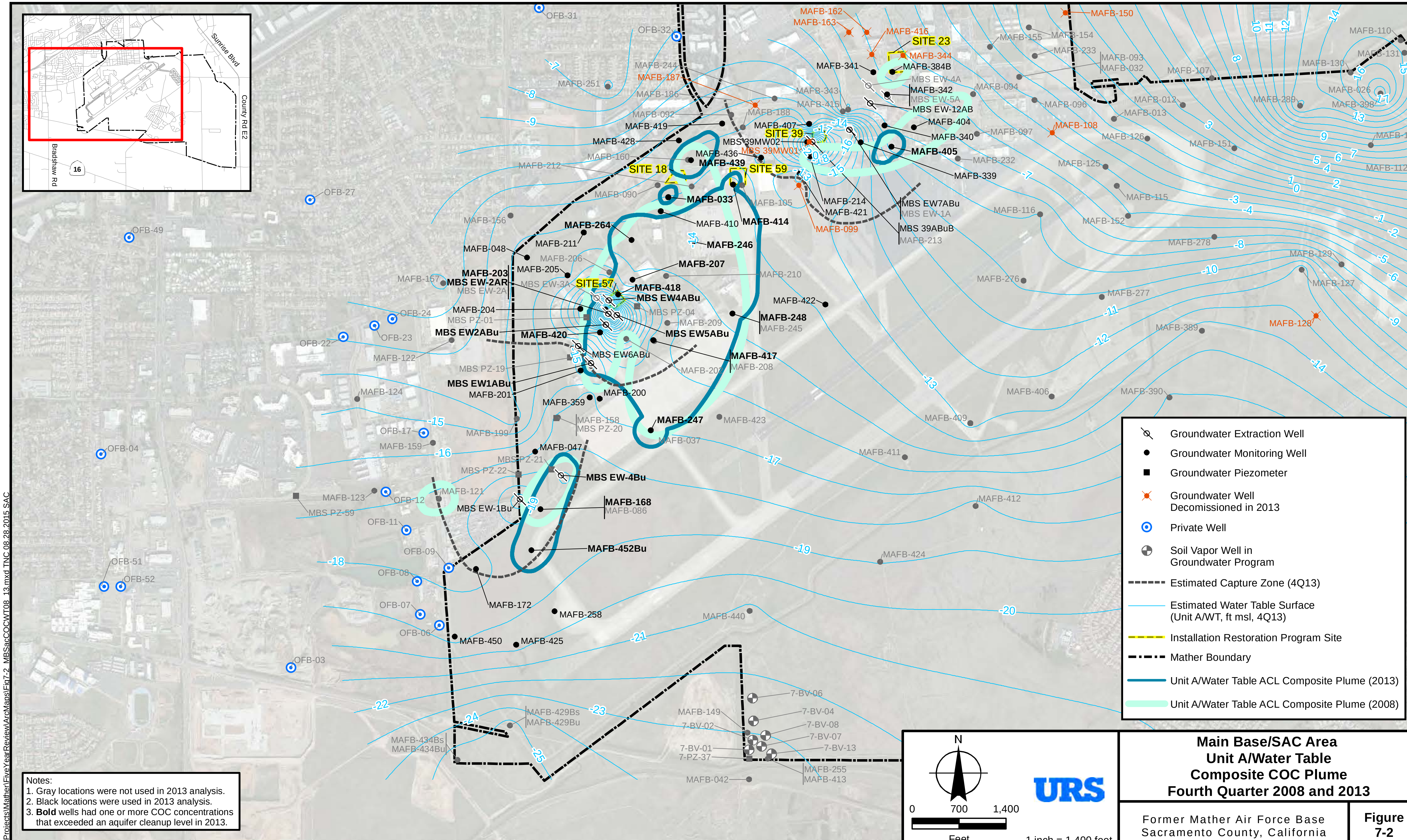
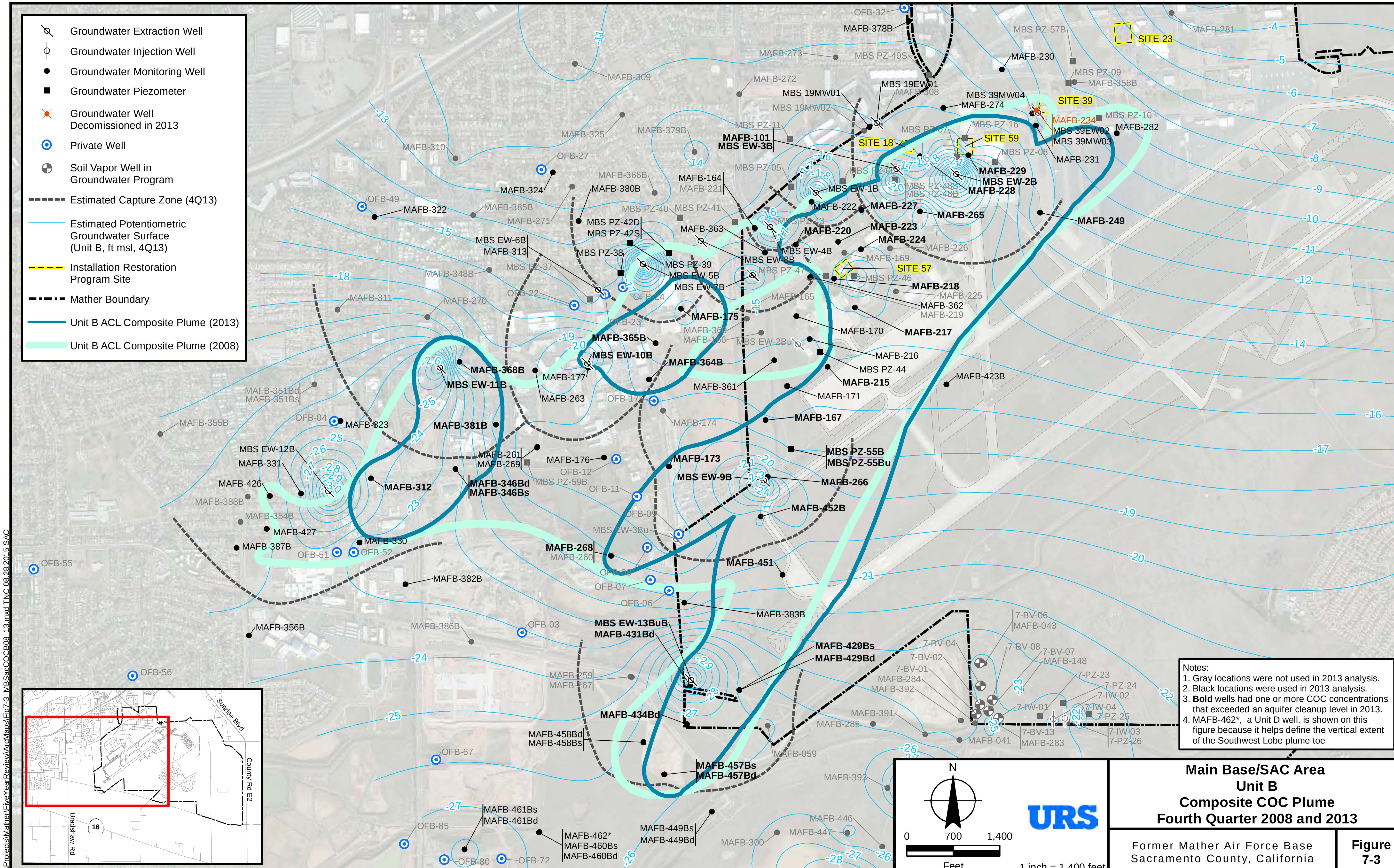
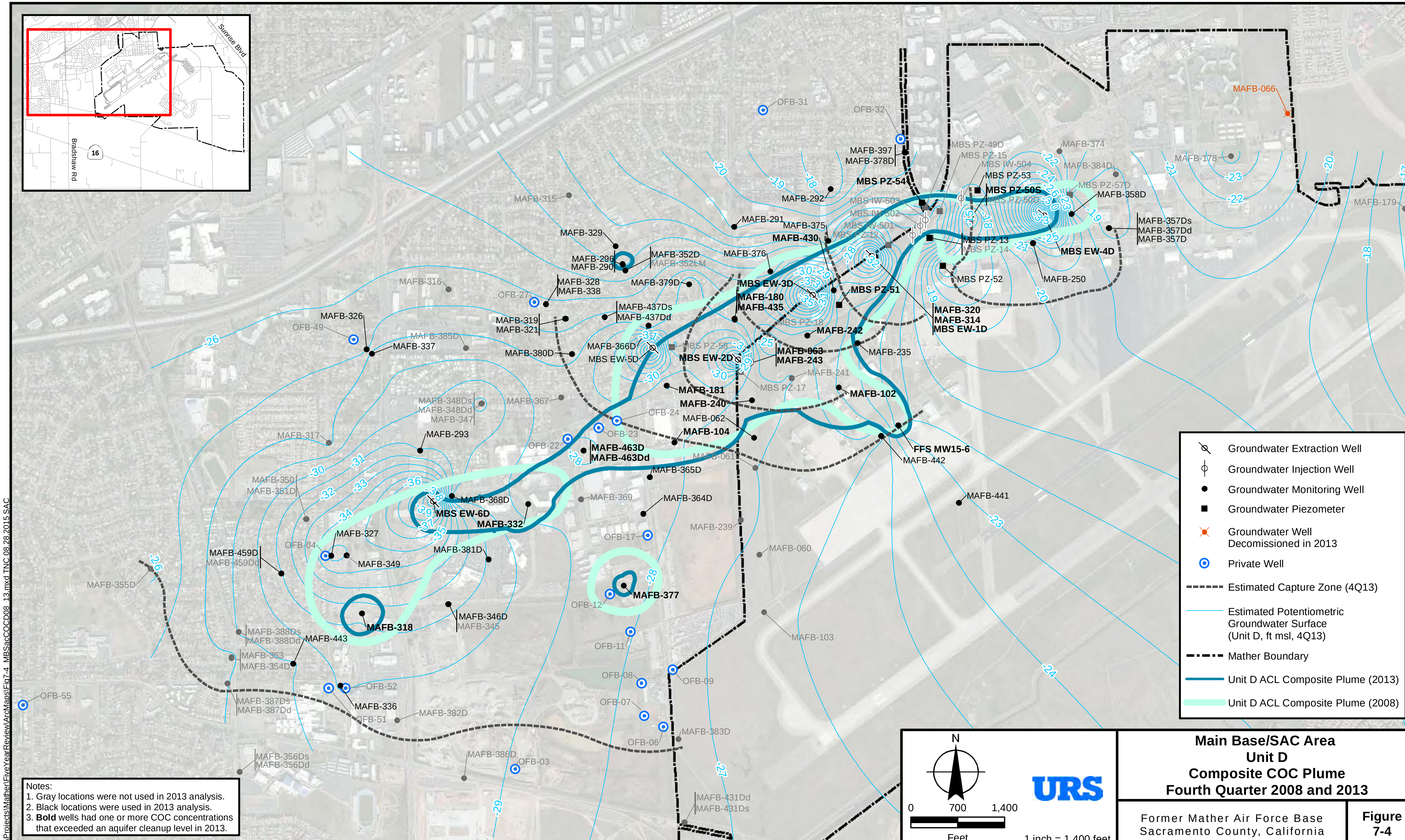


L:\Projects\Mather\FiveYearReview\ArcMaps\Fig7-2_MBSacCOCWT08_13.mxd TNC 08.28.2015 SAC

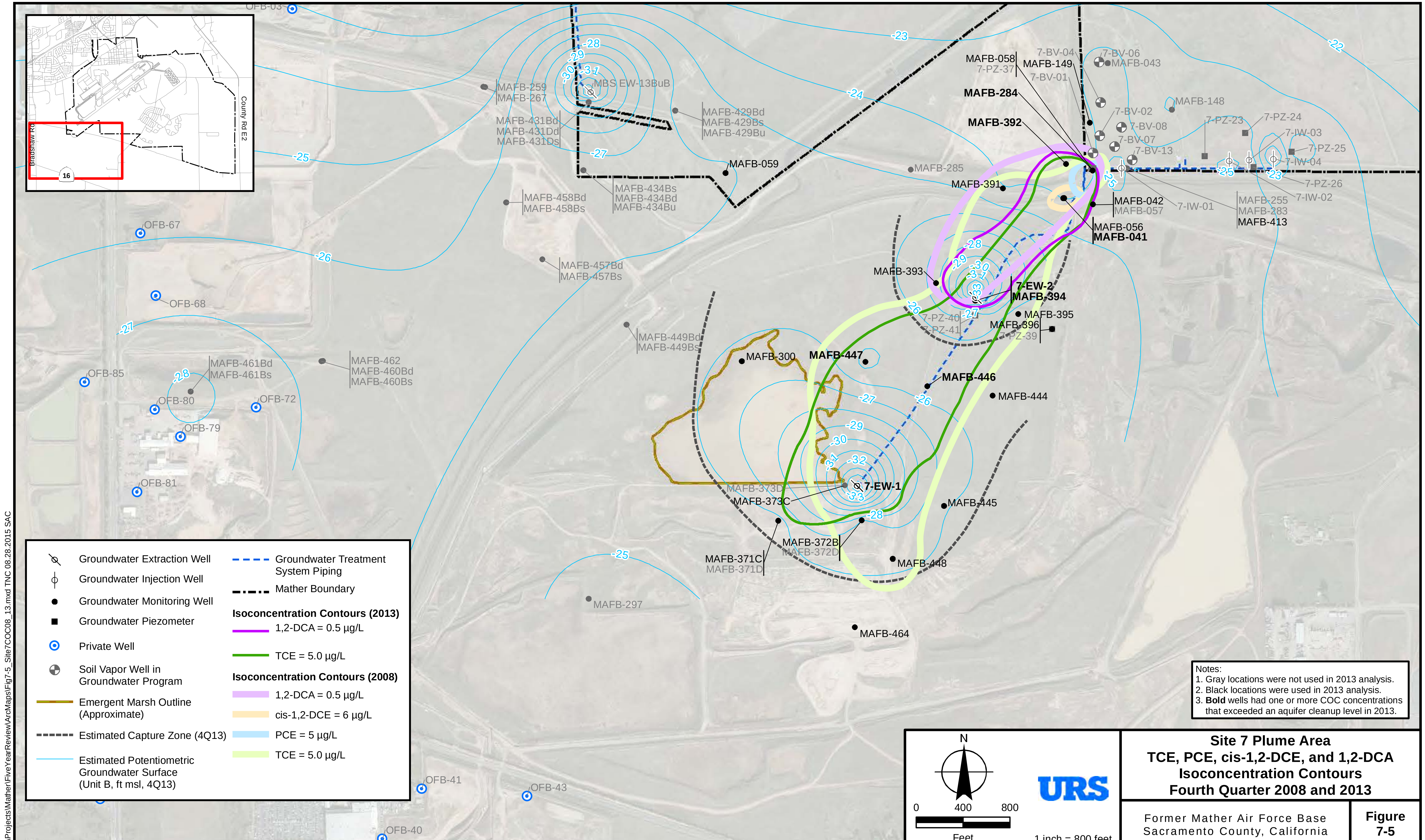

Groundwater Extraction Well
Groundwater Injection Well
Groundwater Monitoring Well
Groundwater Piezometer
Groundwater Well Decommissioned in 2013
Private Well
Soil Vapor Well in Groundwater Program
Estimated Capture Zone (4Q13)
Estimated Potentiometric Groundwater Surface (Unit B, ft msl, 4Q13)
Installation Restoration Program Site
Mather Boundary
Unit B ACL Composite Plume (2013)
Unit B ACL Composite Plume (2008)
SITE 23
SITE 39
SITE 18
SITE 59
SITE 57
Notes:
1. Gray locations were not used in 2013 analysis.
2. Black locations were used in 2013 analysis.
3. Bold wells had one or more COC concentrations that exceeded an aquifer cleanup level in 2013.
4. MAFB-462*, a Unit D well, is shown on this figure because it helps define the vertical extent of the Southwest Lobe plume toe
Sunrise Blvd
County Rd E2
Bradshaw Rd
16
N
0 700 1,400
Feet
1 inch = 1,400 feet
URS
Main Base/SAC Area
Unit B
Composite COC Plume
Fourth Quarter 2008 and 2013
Former Mather Air Force Base
Sacramento County, California
Figure 7-3
L:\Projects\Mather\FiveYearReview\ArcMaps\Fig7-3_MBSacCOCB08_13.mxd TNC 08.28.2015 SAC



Main Base/SAC Area
Unit D
Composite COC Plume
Fourth Quarter 2008 and 2013

Former Mather Air Force Base
Sacramento County, California

Figure 7-4


Groundwater Extraction Well
Groundwater Injection Well
Groundwater Monitoring Well
Groundwater Piezometer
Private Well
Soil Vapor Well in Groundwater Program
Emergent Marsh Outline (Approximate)
Estimated Capture Zone (4Q13)
Estimated Potentiometric Groundwater Surface (Unit B, ft msl, 4Q13)
Groundwater Treatment System Piping
Mather Boundary
Isoconcentration Contours (2013)
1,2-DCA = 0.5 µg/L
TCE = 5.0 µg/L
Isoconcentration Contours (2008)
1,2-DCA = 0.5 µg/L
cis-1,2-DCE = 6 µg/L
PCE = 5 µg/L
TCE = 5.0 µg/L
Notes:
1. Gray locations were not used in 2013 analysis.
2. Black locations were used in 2013 analysis.
3. Bold wells had one or more COC concentrations that exceeded an aquifer cleanup level in 2013.
N
0 400 800
Feet
1 inch = 800 feet
URS
Site 7 Plume Area
TCE, PCE, cis-1,2-DCE, and 1,2-DCA
Isoconcentration Contours
Fourth Quarter 2008 and 2013
Former Mather Air Force Base
Sacramento County, California
Figure 7-5
Bradshaw Rd
County Rd E2
16
7-EW-1
7-EW-2
MAFB-284
MAFB-392
MAFB-041
MAFB-394
MAFB-447
MAFB-446
MAFB-058
MAFB-149
MAFB-391
MAFB-393
MAFB-395
MAFB-396
MAFB-300
MAFB-444
MAFB-445
MAFB-448
MAFB-464
MAFB-297
MAFB-059
MAFB-285
MAFB-148
MAFB-042
MAFB-057
MAFB-056
MAFB-255
MAFB-283
MAFB-413
MAFB-373D
MAFB-373C
MAFB-372B
MAFB-372D
MAFB-371C
MAFB-371D
MAFB-259
MAFB-267
MAFB-431Bd
MAFB-431Dd
MAFB-431Ds
MBS EW-13BuB
MAFB-429Bd
MAFB-429Bs
MAFB-429Bu
MAFB-434Bs
MAFB-434Bd
MAFB-434Bu
MAFB-458Bd
MAFB-458Bs
MAFB-457Bd
MAFB-457Bs
MAFB-449Bd
MAFB-449Bs
MAFB-461Bd
MAFB-461Bs
MAFB-462
MAFB-460Bd
MAFB-460Bs
MAFB-043
OFB-03
OFB-67
OFB-68
OFB-85
OFB-80
OFB-72
OFB-79
OFB-81
OFB-41
OFB-43
OFB-40
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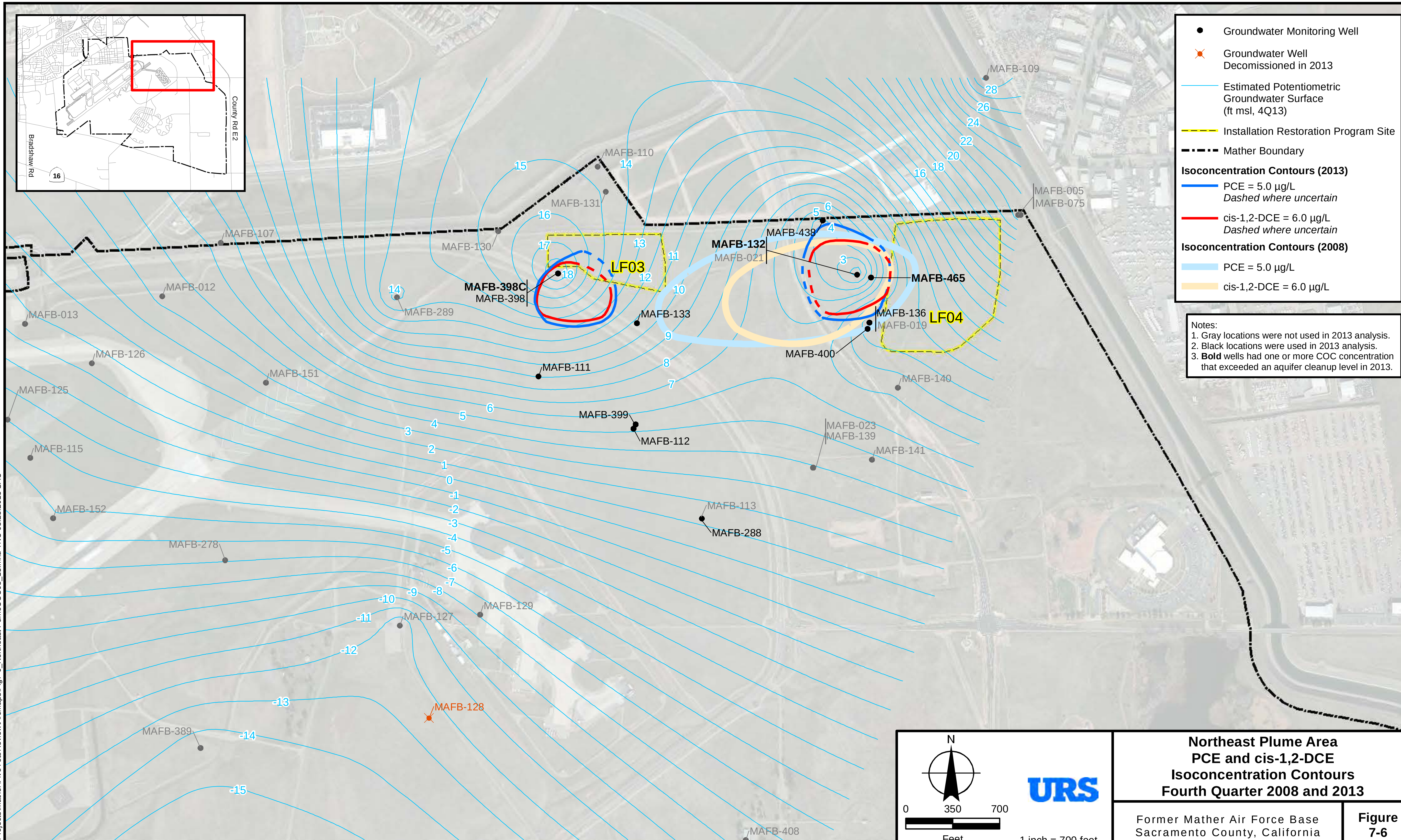
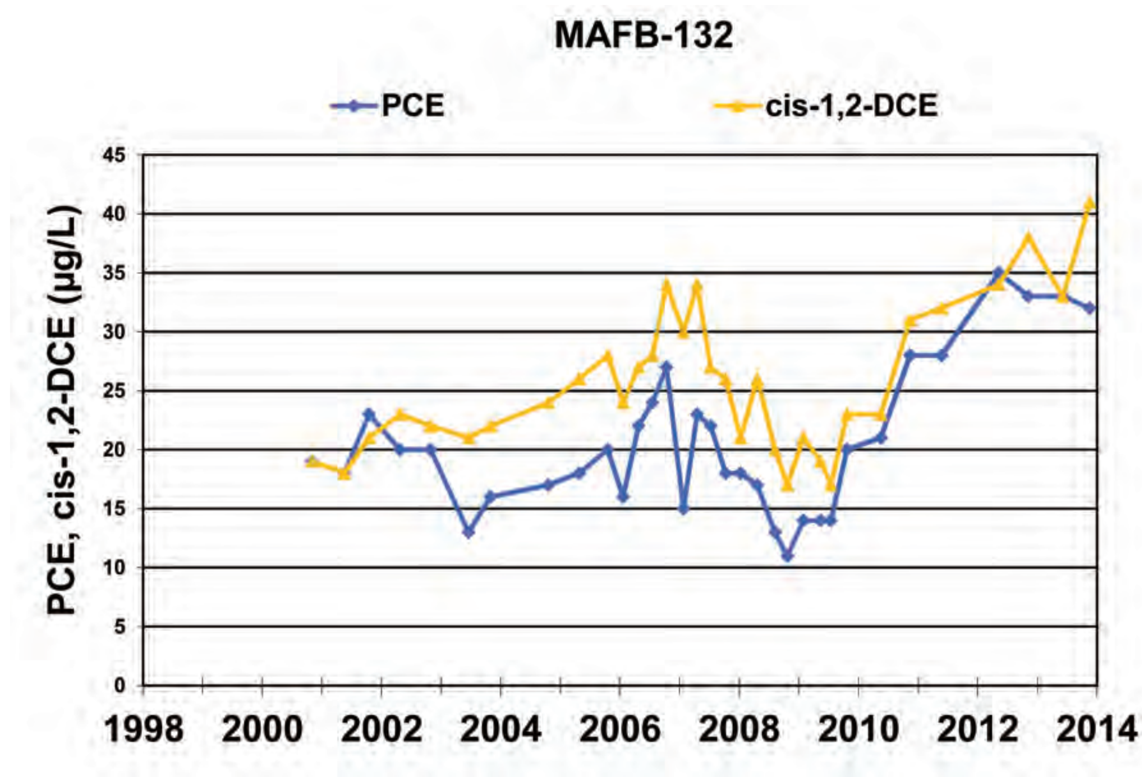


Northeast Plume Area PCE and cis-1,2-DCE Isoconcentration Contours Fourth Quarter 2008 and 2013

Former Mather Air Force Base
Sacramento County, California

Figure 7-6



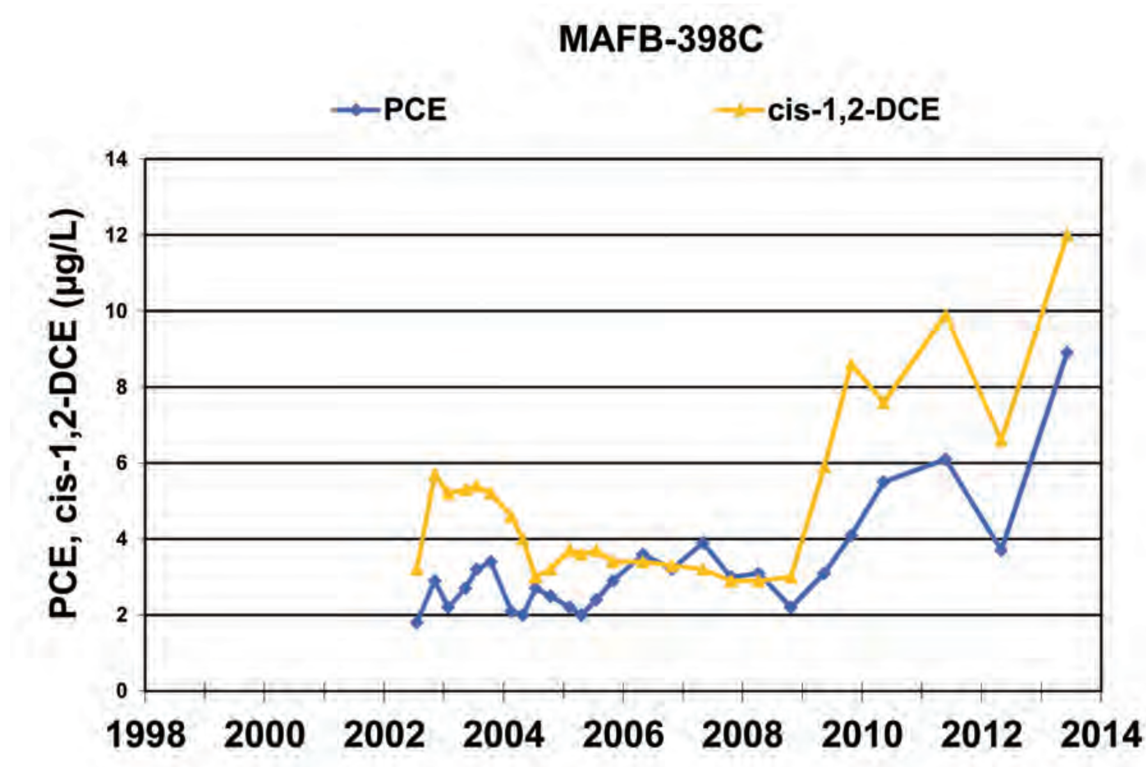


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Figure 7-7. Concentration Trend Graphs for PCE and cis-1,2-DCE at MAFB-132 and MAFB-398C

8.0 ISSUES IDENTIFIED DURING FIVE-YEAR REVIEW, RECOMMENDATIONS, AND FOLLOW-UP ACTIONS

Sections 8.1 through 8.3 discuss the issues identified during this five-year review period and provide recommendations and follow-up actions to address those issues. Table 8-1 summarizes the issues, recommendations, and follow-up actions. No issues that affect protectiveness of the remedies were identified for the sites not listed below, so there are no recommendations or follow-up actions for those sites.

8.1 OU 2 (Groundwater OU)

Main Base/SAC Area Plume Issue. Influent and effluent samples collected in September 2014 from the Main Base/SAC Area groundwater treatment plant and analyzed for PFCs had detections of PFOS at concentrations slightly greater than EPA's Provisional Health Advisory Level of 0.2 μg/L. There are no promulgated cleanup standards for PFCs and no evidence that the remedy is not protective based on the PFC sampling results to date.

Recommendation. Conduct follow-up groundwater sampling for PFC analysis in the Main Base/SAC Area.

Site 7 Plume Issue. Influent and effluent samples collected in September 2014 from the Site 7 groundwater treatment plant and analyzed for PFCs indicated the presence of PFCs. There are no promulgated cleanup standards for PFCs and no evidence that the remedy is not protective based on the PFC sampling results to date.

Recommendation. Conduct follow-up groundwater sampling for PFC analysis in the Site 7 Plume.

8.2 OU 3 (Soil OU)

Site SD-59 Issue. As discussed in Section 7.4.4.1, two nested shallow soil vapor wells (59-PW-09A and -09B) were installed and sampled in November 2014 to assess whether another VOC source was present at Building 4260, outside of the current Site SD-59 IC boundary. These wells contained TCE at 5.7 and 7 ppmv, respectively, suggesting that the original Site SD-59 VOC source has been remediated but that another source area may exist near Building 4260 (see Figure 4-10). Building 4260 is mostly a large, open, hangar-type structure that is likely well-ventilated, mitigating vapor intrusion issues. However, there are offices located along the south wall, closer to the new wells, and these more enclosed spaces are a potential concern. The recent shallow soil vapor sampling results exceed the calculated TCE commercial/industrial soil vapor screening level of 0.558 ppmv (calculated from DTSC recommended industrial indoor air screening values [DTSC, 2014] and attenuation factors [DTSC, 2011a]). However, assuming the screening values represent a 1E-06 cancer risk, the concentrations detected (maximum 7 ppmv) would represent a 1.25E-05 risk, which is within the EPA risk management range of 1E-04 to 1E-06. This value also corresponds to a noncancer hazard index value of 4.7 (based on 1.5 ppmv TCE corresponding to a noncancer hazard index of 1.0). These concentrations suggest that additional investigation and assessment activities are necessary in this area. Also, the IC boundary should be extended to the south and east to include this area.

Recommendation. Further assess the extent of VOCs near Building 4260, which may be a new source area. Expand the IC boundary to the south and east to protect human health from the potential risk associated with inhalation of VOCs via the vapor intrusion pathway. Expansion of the IC boundary would be a minor change to the Soil OU and Groundwater OU ROD and would be accomplished with cooperation by the land owner and an appropriate decision document (e.g., ESD or memorandum to the site file).

Table 8-1. Issues Identified During This Five-Year Review, Recommendations, and Follow-Up Actions

Issues	Recommendations and Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Current Protective-ness (Yes/No)	Affects Future Protective-ness (Yes/No)
Groundwater OU – Main Base/SAC Area Plume. Influent and effluent samples collected from the Main Base/SAC Area groundwater treatment plant had detections of perfluorooctane sulfonate at concentrations slightly greater than EPA's Provisional Health Advisory Level.	Conduct follow-up groundwater sampling for PFC analysis in the Main Base/SAC Area.	AFCEC	EPA, DTSC, CVWB	9/1/2020	No	Unknown
Groundwater OU – Site 7 Plume. Influent and effluent samples collected from the Site 7 groundwater treatment plant indicate the presence of PFCs.	Conduct follow-up groundwater sampling for PFC analysis in the Site 7 plume area.	AFCEC	EPA, DTSC, CVWB	9/1/2020	No	Unknown
Soil OU – Site SD-59. TCE concentrations in the new shallow vadose zone wells southeast of the site and outside of the IC area may pose an unacceptable threat to human health via the vapor intrusion pathway.	Further assess the extent of VOCs near Building 4260, and expand the IC boundary to the south and east via an appropriate decision document.	AFCEC	EPA, DTSC, CVWB	12/31/2016	No	Yes

AFCEC = Air Force Civil Engineer Center
CVWB = Central Valley Regional Water Quality ControlBoard
DTSC = California Department of Toxic Substances Control
EPA = United States Environmental Protection Agency
IC = institutional control
OU = operable unit
PFCs = perfluorinated compound
SAC = Strategic Air Command
SD = storm drain
TCE = trichloroethene
VOCs = volatile organic compounds

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9.0 PROTECTIVENESS STATEMENT

The following statements address the protectiveness of the remedial actions taken at Mather for each OU.

9.1 OU 1 (AC&W OU)

The remedy at OU 1 (AC&W OU) is protective of human health and the environment.

9.2 OU 2 (Groundwater OU)

The remedies at OU 2 (Groundwater OU) are protective of human health and the environment in the short term due to already existing ICs. For the remedy to be protective in the long-term, the following actions need to be taken: the presence and magnitude of PFCs in groundwater must be determined; potential risks from exposure to PFCs must be evaluated; and appropriate remedies (if any) must be determined and documented in appropriate decision documents.

9.3 OU 3 (Soil OU)

The remedies at OU 3 (Soil OU) are protective of human health and the environment in the short term. However, for the Soil OU remedies to be protective in the long term, the IC boundary at Site SD-59 needs to be expanded to the south and east to address the potential risk to human health from the vapor intrusion pathway. Investigation and risk assessment activities are also needed at Building 4260, where a new source area may have been discovered.

9.4 OU 4 (Landfill OU)

The remedies at OU 4 (Landfill OU) are protective of human health and the environment.

9.5 OU 5 (Basewide OU)

The remedies at OU 5 (Basewide OU) are protective of human health and the environment.

9.6 OU 6 (Supplemental Basewide OU)

The remedy at OU 6 (Supplemental Basewide OU) is protective of human health and the environment.

9.7 Comprehensive Protectiveness Statement for Mather

The remedial actions at Mather AFB are short-term protective of human health and the environment. For the remedies to be protective in the long term, the IC boundary at Site SD-59 needs to be expanded to the south and east to address the potential risk to human health from the vapor intrusion pathway and additional investigation and risk assessment activities are needed at Building 4260 (which may be a new site). For groundwater, presence and magnitude of PFCs in groundwater must be determined; potential risks from exposure to PFCs must be evaluated; and appropriate remedies (if any) must be determined and documented in appropriate decision documents.

AUTHORIZING SIGNATURES

18 SEP 15

DAVID H. DENTINO, GS-15, DAF
Deputy Director
Installations Directorate
Air Force Civil Engineering Center
U.S. Air Force

Date

10.0 NEXT FIVE-YEAR REVIEW

The fifth five-year review for Mather will span the time period from the completion of this fourth five-year review, which is planned to be no later than 30 September 2015, until the report preparation, and the final fifth five-year review report will be due no later than five years after the date of Air Force signature on this five-year review. Actions taken in response to recommendations in this fourth five-year review and any future optimization of or modifications made during the review period to the remedies selected in the five RODs will be evaluated in the fifth five-year review to ensure that the remedies continue to be protective of human health and the environment.

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11.0 REFERENCES

ADVENT Environmental, Inc., 2012. *Technical Project Report: Well and System Decommissioning, Former Mather AFB, Sacramento County, California*. Final. September.

Air Force Base Conversion Agency (AFBCA), 1993. *Superfund Record of Decision: Aircraft Control and Warning Site, Mather Air Force Base, Sacramento County, California*. December.

AFBCA, 1995a. *Superfund Record of Decision, Landfill Operable Unit Sites, Mather Air Force Base, Sacramento County, California*. July.

AFBCA, 1995b. *Proposed Plan for Environmental Cleanup at the Groundwater Operable Unit Plumes and Soil Operable Unit Sites*. May.

AFBCA, 1996a. *Superfund Record of Decision, Soil Operable Unit Sites and Groundwater Operable Unit Plumes, Mather Air Force Base, Sacramento County, California*. April.

AFBCA, 1996b. *Explanation of Significant Difference from the Record of Decision, Consolidation of Additional Refuse & Debris into Landfill Site 4*. Draft Final. October.

AFBCA, 1996c. *Removal Action Memorandum Mather AFB IRP Basewide Operable Unit, Site 10C: Fire Training Area Number 3, Time-Critical Removal*. September.

AFBCA, 1996d. *Removal Action Memorandum, Mather AFB IRP Landfill Operable Unit Site 2: The '8150' Area Landfill, Time-Critical Removal*. September.

AFBCA, 1997a. *Explanation of Significant Difference to the AC&W OU Record of Decision: Discharge of Treated Groundwater to Mather Lake.* June.

AFBCA, 1997b. *Proposed Plan for Environmental Cleanup at the Basewide Operable Unit Sites*. May.

AFBCA, 1997c. *Removal Action Memorandum, Mather Air Force Base, Basewide Operable Unit, Site 85: South Ditch*. October.

AFBCA, 1998a. *Explanation of Significant Differences from the Record of Decision, Disposal of Contaminated Soil at Site 7/11*. Final. September.

AFBCA, 1998b. *Explanation of Significant Differences, Soil Operable Unit Sites and Groundwater Operable Unit Plumes Record of Decision for Sites 56, 59, and 60*. December.

AFBCA, 1998c. *Record of Decision, Basewide Operable Unit Sites, Mather Air Force Base, California*. August.

AFBCA, 1998d. *Aircraft Control and Warning Site, Groundwater Pump-and-Treat System, Report of Proper and Successful Operation*. September.

AFBCA, 1998e. *Mather AFB Off-Base Water Supply Contingency Plan*. Final. February.

AFBCA, 1999a. *Five-Year Review of Remedial Actions*. September.

AFBCA, 1999b. *Removal Action Memorandum, Mather Air Force Base Supplemental Basewide Operable Unit, Site 80: Morrison Creek and Site 88: Golf Course Maintenance Area Ditch*. July.

AFBCA, 2000. *Proposed Plan for Environmental Cleanup at the Supplemental Basewide Operable Unit Sites*. September.

AFBCA, 2001a. *Removal Action Memorandum (RAM) to Change Scope of Continued Response for Non-Time-Critical Removal Actions Initiated Under the 1997 RAM for Site 85 and 1999 RAM for Site 80 and Site 88, Mather Air Force Base, California*. June.

AFBCA, 2001b. *Removal Action Memorandum Mather Air Force Base Supplemental Basewide Operable Unit, Site 89: Old Trap Range*. June.

AFBCA, 2002. *Northeast Plume Evaluation Report, Northeast Plume, Groundwater Operable Unit, Mather AFB, California*. Final. April.

Air Force Center for Environmental Excellence, 1993. *Proposed Plan for Environmental Cleanup at the Mather Air Force Base Landfill Operable Unit Sites*. December.

Air Force Civil Engineer Center (AFCEC), 2013. *Mather Air Force Base, Off-Base Water Supply Contingency Plan*. Revision 2. Final. July.

AFCEC, 2014. *2013 Annual Report of Compliance with Institutional Controls at the Former Mather Air Force Base*. July.

Air Force Real Property Agency (AFRPA), 2005. *Second Five-Year Review of Remedial Actions*. Final. July.

AFRPA, 2006. *Record of Decision for the Supplemental Basewide Operable Unit Sites, Mather Air Force Base, Sacramento County, California*. Final. October.

AFRPA, 2008a. *Explanation of Significant Difference: Institutional Controls for Groundwater Remedy, Site WP-12, Aircraft and Control Warning Site, Mather, California*. Final. November.

AFRPA, 2008b. *Explanation of Significant Difference from the Record of Decision Excavation of Shallow Soil Contaminated with Lead at Site 10C/68*. Final. August.

AFRPA, 2008c. *Mather AFB Off-Base Water Supply Contingency Plan*. Revision 1. Final. November.

AFRPA, 2009a. *Memorandum of Post-ROD Changes: Clarification of Institutional Controls for the Landfill Operable Unit Remedies, Mather, California*. Final. August.

AFRPA, 2009b. *Remedial Action Report for Installation Restoration Program Site OT-87, Rod and Gun Club Skeet and Trap Range (Facility 10330), Mather, California*. Final. September.

AFRPA, 2009c. Memorandum for California American Water Company, Regarding Six-Month Advance Notification of Termination of Air Force Wellhead Treatment Maintenance at the Moonbeam Drive Well. 9 March.

AFRPA, 2010a. *Explanation of Significant Difference from the Record of Decision for the Soil Operable Unit Sites and Groundwater Operable Unit Plumes: Soil Sites WP-07/FT-11, ST-37/ST-39/SS-54, SD-57, SD-59, OT-69; Main Base/SAC Area Plume, Site 7 Plume, Northeast Plume, Mather, California*. Revised Final. February (signatures completed in August 2010).

AFRPA, 2010b. *Explanation of Significant Difference from the Record of Decision for the Basewide Operable Unit Sites: Sites FT-10C/ST-68, LF-18, OT-23C, and OT-87, Mather, California*. Final. June (signatures completed in August 2010).

AFRPA, 2010c. *Report of Compliance with Institutional Controls at the Former Mather Air Force Base, September 2006 through August 2010*. Final. September.

AFRPA, 2010d. *Predictive Trend Analysis for the Northeast Plume Contaminants of Concern (COCs), Former Mather Air Force Base.* August.

AFRPA, 2011a. *Demonstration of Operating Properly and Successfully (OPS) for the Main Base/SAC Area Groundwater Plume and Six Soil Sites, Former Mather Air Force Base, Sacramento County, California*. March.

AFRPA, 2011b. *Demonstration of Operating Properly and Successfully (OPS) for the Site 7 Groundwater Plume and Soil Sites 7 and 11, Former Mather Air Force Base, Sacramento County, California*. June.

AFRPA, 2011c. *Report of Proper and Successful Operation for the Northeast Plume Groundwater Remedial Action at the Former Mather Air Force Base, California*. Revised Final. March.

AFRPA, 2011d. *Restoration Advisory Board (RAB) Adjournment Report, Former Mather Air Force Base (AFB), Sacramento, CA*. August.

AMEC, 2014. *Perfluorinated Compound Detections from Groundwater Treatment Plants (GWTP) at the former Mather Air Force Base (AFB)*. 20 November.

AMEC, 2015. *Final Installation-Specific Work Plan Addendum, Former Mather Air Force Base: Perfluorinated Compounds (PFCs) Release Determination at Multiple BRAC Bases*. March.

California Department of Toxic Substances Control (DTSC). 2011a. *Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance).*October.

DTSC, 2011b. Letter to Douglas V. Fortun, AFRPA WREC, Regarding Final Site 10C/68 Closure Report, Former Mather Air Force Base, California. 26 May.

DTSC, Office of Human and Ecological Risk, 2014. *Human Health Risk Assessment (HHRA) Note 3*. http://www.dtsc.ca.gov/AssessingRisk/upload/HHRA-Note-3-2.pdf. July.

California Regional Water Quality Control Board–Central Valley Region (CVWB), 2011. Letter to Douglas Fortun, AFRPA WREC, Regarding Final Site 18 and 23A Closure Report, Former Mather Air Force Base (AFB), Sacramento County and Final Site 10C/68 Closure Report, Former Mather Air Force Base (AFB), Sacramento County. 7 February.

EA Engineering, Science, and Technology (EA Engineering), 1995. *Operations and Maintenance Manual, AC&W Site Pump and Treat System*. July.

EA Engineering, 1997. *Site Investigation and SVE System Installation Report Site 10C/68, Former Mather Air Force Base, Sacramento County, California*. December.

Eisler, R., 1998. *Contaminant Hazard Reviews*. [Reports No. 1-28 on CD-ROM]. U.S. Department of the Interior, U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, Maryland.

EOD Technology, Inc., 1999. *OE Characterization Report at the Weapons Storage Area, Mather Air Force Base, Mather, California*. Final.

Headquarters Air Training Command, 1991. *Proposed Plan for Groundwater Cleanup at Mather Air Force Base, Aircraft Control and Warning Site*. August.

Headquarters Air Training Command, 1992. *Revised Proposed Plan for Groundwater Cleanup at the Aircraft Control and Warning Site*. March.

IT Corporation, 1991a. *U.S. Air Force Installation Restoration Program, Final Remedial Investigation Report of the AC&W Site for Mather Air Force Base, California*. Final. March.

IT Corporation, 1991b. *U.S. Air Force Installation Restoration Program Feasibility Study for Mather Air Force Base, California, AC&W Site*. Final. August.

IT Corporation, 1993a. *Remedial Investigation for Group 2 Sites, Mather Air Force Base, California*. Final. April.

IT Corporation, 1993b. *U.S. Air Force Installation Restoration Program, Technical Memorandum for Group 3 Sites for Mather Air Force Base, California*. Final. September.

IT Corporation, 1993c. *Landfill Operable Unit Focused Feasibility Study, Mather Air Force Base, California*. October.

IT Corporation, 1994a. *Soil and Groundwater Operable Units Additional Field Investigation, Remedial Investigation Report for Mather Air Force Base, California*. Final August.

IT Corporation, 1994b. *Removal Action Memorandum for Sites 20, 29, and 32, Mather Air Force Base, California.* September.

IT Corporation, 1995a. *Groundwater Operable Unit and Soil Operable Unit Focused Feasibility Study Report for Mather Air Force Base, California*. Final. March.

IT Corporation, 1995b. *Mather Baseline Risk Assessment for Mather Air Force Base, California*. Final. December.

IT Corporation, 1996a. *Additional Site Characterization and Basewide Operable Unit Remedial Investigation Report for Mather Air Force Base, California*. Final. September.

IT Corporation, 1996b. *Technical Information Report on Soil Vapor Extraction Pilot Testing at Installation Restoration Program Sites 18, 39, and 57*. Draft. March.

IT Corporation, 1996c. *Comprehensive Baseline Risk Assessment for Mather Air Force Base, California*. Final. October.

IT Corporation, 1997a. *Site Characterization Report for Sites 86 and 87 for Mather Air Force Base, California*. Final. February.

IT Corporation, 1997b. *Basewide Operable Unit Focused Feasibility Study Report for Mather Air Force Base, California*. Final. March.

IT Corporation, 2000. *Supplemental Basewide Operable Unit Focused Feasibility Study Report, Mather Air Force Base, California*. Final. September.

Montgomery Watson, 1996. *Closure and Post-Closure Maintenance Plan for the Landfill Operable Unit.* April.

Montgomery Watson, 1997a. *Addendum to the Operations and Maintenance Manual, AC&W Site Pump and Treat System.* July.

Montgomery Watson, 1997b. *Closure Report for Soil Operable Unit Site 65 and Remedial Action Characterization Report for Soil Operable Unit Sites 56, 59, 60, and 62*. April.

Montgomery Watson, 1999a. *Informal Technical Information Report and Preliminary Engineering Report for Vadose Zone Source Removal at Sites 18, 23, and 59*. August.

Montgomery Watson, 1999b. *Informal Technical Information Report for the Installation of Guard Wells.* August.

Montgomery Watson, 1999c. *Operations and Maintenance Manual for the Groundwater Extraction and Treatment System for the Site 7 Plume*. March.

Montgomery Watson, 1999d. *Closure and Post-Closure Maintenance Plan for the Engineered Cap at Remedial Action Site 7*. Final. July.

Montgomery Watson, 1999e. *Landfill LF04 Methane Gas Migration Contingency Plan, Mather Air Force Base, California*. February.

Montgomery Watson, 1999f. *Informal Technical Information Report for Remedial Actions at Sites 15, 20, 85, 86, and 87.* August.

Montgomery Watson, 2000a. *Informal Technical Information Report for Remedial Actions at Sites 37, 39, and 54*. February.

Montgomery Watson, 2000b. *Informal Technical Information Report for Investigations and Pilot Study at Site 89*. February.

Montgomery Watson, 2000c. *Addendum to the Final Basewide Groundwater Monitoring Sampling and Analysis Plan for Landfill Gas Monitoring – Revision 1*. Final. February.

Montgomery Watson, 2000d. *Soil Vapor Extraction/Bioventing Quarterly Monitoring Report Sites: 7, 10C/68, 11, 18, 19, 23, 24, 34, 35/36, 37/39/54, 56, 57, 59, 60, 2595, 18015, Second Quarter 2000*. August.

MWH Americas, Inc. (MWH), 2002a. *Informal Technical Information Report for Additional Excavation at Site 89*. June.

MWH, 2002b. *Informal Technical Information Report for Additional Excavations at Installation Restoration Program Sites 80, 85, and 88*. July.

MWH, 2003a. *Operations and Maintenance Manual for the Groundwater Extraction and Treatment System Main Base/SAC Plume (Phase I, Phase II, Phase III, and Phase IV)*. Final. February.

MWH, 2003b. *Annual and Fourth Quarter 2002 Mather Groundwater Monitoring Report*. Final. August.

MWH, 2004. *Mather Community Relations Plan*. Final. August.

MWH, 2007a. *Capture Zone Analysis, Main Base/SAC Area Plume, Former Mather Air Force Base, Sacramento County California*. Final. August.

MWH, 2007b. *2006 Groundwater Monitoring Program Evaluation Report*. February.

MWH, 2009a. *Letter Report for Basewide Well and System Decommissioning*. July.

MWH, 2009b. *Lead Excavation Completion Report, Site 10C/68, Mather Air Force Base, California*. Final. November.

MWH, 2009c. *2009 Groundwater Monitoring Program Sampling Plan*. Final. April.

MWH, 2009d. *Soil Vapor Extraction and Bioventing Remedial Treatment Systems Operations and Maintenance Manual for Sites 7/11, 10C/68, 23C, 29/71, 37/39/54, 57, and 18/59*. Final. March.

MWH, 2009e. *Results of 2008 Small Mammal Monitoring at Site 87*. Draft Final. May.

MWH, 2009f. *2008 Soil Vapor Extraction/Bioventing Annual Monitoring Report for Sites 7/11, 10C/68, 18, 23C, 29/71, 37/39/54, 57, and 59*. March.

MWH, 2010a. *Site 10C/68 Closure Report, Former Mather Air Force Base, Sacramento County, California*. Final. May.

MWH, 2010b. *Site 18 and 23A Closure Report, Former Mather Air Force Base, Sacramento County, California*. Final. October.

MWH, 2010c. *Results of 2009 Small Mammal Monitoring at Site 87, Former Mather Air Force Base, Sacramento County, California*. Final. September.

MWH, 2010d. *Annual and Fourth Quarter 2008 Mather Groundwater Monitoring Report*. Final. January.

MWH, 2010e. *Operations and Maintenance Manual for the Groundwater Extraction and Treatment System, AC&W Plume (Previously Issued May 1995), Former Mather Air Force Base, Sacramento County, California*. Final. May.

MWH, 2010f. *Addendum to the Operations and Maintenance Manual for the Groundwater Extraction and Treatment System, Main Base/SAC Plume (Phase I, Phase II, Phase III, and Phase IV) (Previously Issued March 2003), Former Mather Air Force Base, Sacramento County, California*. Final. May.

MWH, 2010g. *Operations and Maintenance Manual for the Groundwater Extraction and Treatment System, Site 7 Plume (Previously Issued March 1999), Former Mather Air Force Base, Sacramento County, California*. Final. May.

MWH, 2010h. *Closure and Post-Closure Maintenance Plan for the Engineered Cap at Remedial Action Site 7 (Previously Issued July 1999)*. Final. March.

MWH, 2010i. *Closure and Post-Closure Maintenance Plan for the Landfill Operable Unit (Previously Issued April 1996)*. Final. March.

MWH, 2010j. *Annual and Fourth Quarter 2009 Mather Groundwater Monitoring Report, Former Mather Air Force Base, Sacramento, California*. Final. October.

MWH, 2010k. *2009 Annual Post-Closure Landfill Inspection and Gas Monitoring Report, Former Mather Air Force Base, Sacramento, California*. March.

MWH, 2010l. *2009 Soil Vapor Extraction/Bioventing Annual Monitoring Report for Sites 7/11, 23C, 29/71, 37/39/54, 57, and 59*. February.

MWH, 2010m. *First and Second Quarter 2010 Post-Closure Landfill Inspection and Gas Monitoring Report, Former Mather Air Force Base, Sacramento, California*. August.

Office of Environmental Health Hazard Assessment (OEHHA), 2009. *Revised California Human Health Screening Levels for Lead*. Integrated Risk Assessment Section, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. September.

OEHHA, 2014. *Public Health Goals*. Online information: http://oehha.ca.gov/water/phg/allphgs.html (last accessed March 2014).

Office of the Deputy Under Secretary of Defense, 2001. *Management Guidance for the Defense Environmental Restoration Program*. September.

Sytsma Group, 2014. Community Relations Plan Update, Former Mather Air Force Base (Mather). Final. December.

United States Air Force, 1989. Interagency Agreement for Mather Air Force Base. Also called the Federal Facility Agreement. July.

United States Department of Defense (DoD), 2012. Department of Defense Manual No. 4715.20 Defense Environmental Restoration Program (DERP) Management. March.

DoD and United States Environmental Protection Agency, 2000. *Interim Final Management Principles for Implementing Response Actions at Closed, Transferring, and Transferred Ranges*. March.

United States Environmental Protection Agency (EPA), 1998. Memorandum from Daniel D. Opalski, Chief, Federal Facilities Cleanup Branch, U.S. EPA, Region IX, to Anthony Wong, BRAC Environmental Coordinator, AFBCA, Mather, California, 25 November.

EPA, 2001. *Comprehensive Five-Year Review Guidance*. OSWER 9355.7-03B-P. June.

EPA, 2002. *Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)*. Draft. EPA 530-D-02-004. Prepared by Office of Solid Waste and Emergency Response, United States Environmental Protection Agency, Washington, D.C. November.

EPA, 2009. Letter to Phillip H. Mook, Jr., AFRPA, Regarding Final Remedial Action Report for Site OT-87, Rod and Gun Club Skeet and Trap Range, Mather, California. 5 November.

EPA, 2011a. *Recommended Evaluation of Institutional Controls: Supplement to the 'Comprehensive Five-Year Review Guidance'*. OSWER Directive 9355.7-18. September.

EPA, 2011b. Letter to Phillip H. Mook, Jr., AFRPA, Regarding Request for EPA Determination of Air Force Compliance with CERCLA Section 120(h)(3) for Soil and Groundwater Remedial Actions, Mather Air Force Base, California. 14 July.

EPA, 2012a. *Memorandum: Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews*. OSWER Directive 9200.2-111. September.

EPA, 2012b. *Memorandum: Assessing Protectiveness at Sites for Vapor Intrusion: Supplement to the 'Comprehensive Five-Year Review Guidance'*. OSWER Directive 9200.2-84. November.

EPA, 2012c. Letter to Phillip H. Mook, Jr., AFRPA, Regarding Site Closure and Decommissioning of the SVE System at Sites FT-10C and ST-68. 28 June.

EPA, 2012d. Letter to Phillip H. Mook, Jr., AFRPA, Regarding Site Closure and Decommissioning of the SVE System at Sites 18 and 23A. 28 June.

EPA, 2014a. *Integrated Risk Information System (IRIS) Database*. National Center for Environmental Assessment, U.S. Environmental Protection Agency, Washington, D.C. Online database: http://www.epa.gov/iris (last accessed May 2014).

EPA, 2014b. *Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites*. RSL Table update. November, 2012. Online database: http://www.epa.gov/region9/superfund//prg/index.html (last accessed June 2014).

URS Group, Inc. (URS), 2010. *Third Five-Year Review Report, Former Mather Air Force Base, Sacramento County, California*. Final. October.

URS, 2011a. *Site 7/11 Soil Vapor Extraction/Biovent System Closure Report, Former Mather Air Force Base, California*. Final. August.

URS, 2011b. *Annual and Fourth Quarter 2010 Mather Groundwater Monitoring Report, Former Mather Air Force Base, California*. Final. November.

URS, 2011c. *2010 Soil Vapor Extraction/Bioventing Annual Monitoring Report, Former Mather Air Force Base, California*. April.

URS, 2011d. *2010 Annual Post-Closure Landfill Inspection and Gas Monitoring Report, Former Mather Air Force Base, Sacramento County, California*. Final. March.

URS, 2012a. *Technical Memorandum for Decommissioning Soil Vapor Monitoring and Extraction Wells and the SVE/BV System at Site 7/11, Former Mather Air Force Base*. August.

URS, 2012b. *2011 Annual Report of Compliance with Institutional Controls, Former Mather Air Force Base, August 2010 through January 2012*. Final. February.

URS, 2012c. *Third Quarter 2012 Surface Water Discharge Report Mather Main Base/SAC Area Groundwater Treatment Plant.* October.

URS, 2012d. *Annual and Fourth Quarter 2011 Mather Groundwater Monitoring Report, Former Mather Air Force Base, California*. Revised Final. September.

URS, 2012e. *2011 Annual Post-Closure Landfill Inspection and Gas Monitoring Report, Former Mather Air Force Base, Sacramento County, California*. February.

URS, 2012f. *2011 Soil Vapor Extraction/Bioventing Annual Monitoring Report, Former Mather Air Force Base, California*. April.

URS, 2013a. *Technical Memorandum for Decommissioning Select Site-wide Groundwater Monitoring and Extraction Wells, Former Mather AFB.* August.

URS, 2013b. *2012 Annual Report of Compliance with Institutional Controls at the Former Mather Air Force Base*. Final. March.

URS, 2013c. *2013 Landfill Orthophotographic Survey Report, Former Mather Air Force Base, Sacramento County, California*. August.

URS, 2013d. *2012 Annual Post-Closure Landfill Inspection and Gas Monitoring Report, Former Mather Air Force Base, Sacramento County, California*. February.

URS, 2013e. *Annual and Fourth Quarter 2012 Mather Groundwater Monitoring Report, Former Mather Air Force Base, California*. June.

URS, 2013f. *2012 Soil Vapor Extraction/Bioventing Annual Monitoring Report, Former Mather Air Force Base, California*. March.

URS, 2014a. *Site 57 Vadose Zone Closure Report, Former Mather Air Force Base*, *California*. Draft. April (postponed).

URS, 2014b. *Annual and Fourth Quarter 2013 Mather Groundwater Monitoring Report, Former Mather Air Force Base, California*. April.

URS, 2014c. *2013 Annual Post-Closure Landfill Inspection and Gas Monitoring Report, Former Mather Air Force Base, Sacramento County, California*. February.

URS, 2014d. *2013 Soil Vapor Extraction/Bioventing Annual Monitoring Report, Former Mather Air Force Base, California*. March.

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APPENDIX A

Operational and Remedial Histories of the SVE/Bioventing Systems

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OPERATIONAL AND REMEDIAL HISTORY
SITE WP-07/FT-11 SVE/BIOVENT SYSTEM
FORMER MATHER AIR FORCE BASE
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	Event	Start Date	End Date
1)	Construction Bids and Procurement	15-Jul-97	3-Oct-97
2)	SVE System Procurement	28-Jul-97	3-Oct-97
3)	Well Drilling and Installation	29-Aug-97	1-Jan-98
4)	Perched Zone Dewatering	1-Jan-98	1-Apr-98
5)	SVE Pilot Test	1-Apr-98	1-Jun-98
6)	SVE System Installation	29-Jun-98	28-Sep-98
7)	SVE System Startup and Proveout	21-Sep-98	19-Feb-99
8)	SVE System Operation (Catalytic Mode)	4-Mar-99	13-May-99
9)	SVE System Shut Down and Aboveground Piping Removed During Construction of Engineered Landfill Cap	14-May-99	25-Oct-99
10)	Aboveground Piping Reinstallation	26-Oct-99	17-Dec-99
11)	Rotary Lobe Blower Repair	26-Nov-99	1-Jan-00
12)	SVE System was Restarted for Compliance and Wellhead Sampling, then Shut Down	4-Feb-00	8-Feb-00
13)	SVE System was Restarted for Compliance and Wellhead Sampling, then Shut Down	28-Feb-00	8-Mar-00
14)	SVE System was Restarted and Optimized	31-Mar-00	18-Apr-00
15)	SVE System was Shut Down for Rebound Test	19-Apr-00	15-May-00
16)	Catalyst was Removed and SVE System Operated in Thermal Mode	16-May-00	22-May-00
17)	SVE System was Shut Down for Respiration Test	23-May-00	12-Jun-00
18)	SVE System Operation (Thermal Mode)	13-Jun-00	28-Jun-00
19)	SVE System was Shut Down for Rebound Test	29-Jun-00	7-Jul-00
20)	SVE System Operation (Thermal Mode)	7-Jul-00	11-Aug-00
21)	SVE System was Shut Down for Weekly Cycling and Repairs to Pressure Switch	11-Aug-00	29-Aug-00

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	Event	Start Date	End Date
22)	SVE System Operation Cycled (4 days on, 3 days off)	29-Aug-00	30-Nov-00
23)	SVE System was Shut Down for Rebound Test	30-Nov-00	14-Dec-00
24)	SVE System Operation (Thermal Mode)	14-Dec-00	22-Dec-00
25)	SVE System was Shut Down for Rebound Test	22-Dec-00	3-Jan-01
26)	SVE System Operation (Thermal Mode)	3-Jan-01	1-Feb-01
27)	SVE System was Shut Down for Rebound Test	1-Feb-01	6-Mar-01
28)	SVE System Operation (Thermal Mode)	6-Mar-01	4-Sep-01
29)	SVE System was Shut Down for Gas Migration Sampling at Landfill Site 7	4-Sep-01	13-Sep-01
30)	SVE System was Restarted for Compliance Sampling	13-Sep-01	14-Sep-01
31)	SVE System was Shut Down for Gas Migration Sampling at Landfill Site 7	14-Sep-01	28-Sep-01
32)	SVE System Operation (Thermal Mode)	28-Sep-01	1-Oct-01
33)	SVE System was Shut Down Due to Propane Refueling Issues (heightened airport security)	1-Oct-01	10-Oct-01
34)	SVE System Operation Cycled (4 days off, 3 days on)	10-Oct-01	5-Nov-01
35)	SVE System was Shut Down Due to Propane Refueling Issues (Heightened Airport Security)	5-Nov-01	14-Nov-01
36)	SVE System Operation Cycled (4 days off, 3 days on)	14-Nov-01	8-Mar-02
37)	SVE System was Shut Down for Rebound Test	8-Mar-02	1-Apr-02
38)	SVE System Operation Cycled (4 days off, 3 days on)	1-Apr-02	18-Jun-02
39)	SVE System was Shut Down for Rebound Test	18-Jun-02	3-Jul-02
40)	SVE System Operation Cycled (4 days off, 3 days on)	3-Jul-02	23-Aug-02
41)	SVE System was Shut Down for Rebound Test	23-Aug-02	4-Sep-02
42)	SVE System Operation Cycled (4 days off, 3 days on)	4-Sep-02	7-Oct-02

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	Event	Start Date	End Date
43)	Installation of Horizontal Extraction Well 7-HBV-16	20-Sep-02	20-Sep-02
44)	Aspiration Test at 7-MP-5	17-Sep-02	22-Oct-02
45)	SVE System was Shut Down for Rebound Test	7-Oct-02	22-Oct-02
46)	SVE System Operation Cycled (4 days off, 3 days on)	22-Oct-02	21-Nov-02
47)	Shut Down for SMAQMD Substantive Requirement Compliance Issue	5-Nov-02	6-Nov-02
48)	SVE System was Shut Down for Rebound Test	21-Nov-02	11-Dec-02
49)	SVE System Operation Cycled (4 days off, 3 days on)	11-Dec-02	6-Jan-03
50)	SVE System Operation Cycled (4 days on 3 days off)	6-Jan-03	7-Mar-03
51)	SVE System was Shut Down for Quarterly Landfill Monitoring	7-Mar-03	20-Mar-03
52)	SVE System Operation Cycled (4 days off, 3 days on)	20-Mar-03	23-May-03
53)	SVE System was Shut Down for Rebound Test and Quarterly Landfill Monitoring	23-May-03	30-Jun-03
54)	SVE System Operation Cycled (4 days off, 3 days on)	30-Jun-03	2-Aug-03
55)	SVE System Shut Down for Quarterly Landfill Monitoring	2-Aug-03	13-Aug-03
56)	SVE System Operation Cycled (4 days off, 3 days on)	13-Aug-03	26-Aug-03
57)	SVE System Operation on Continuous Schedule	26-Aug-03	18-Nov-03
58)	SVE System Shut Down for Rebound Test, Quarterly Landfill Monitoring, and Blower Motor Repairs	18-Nov-03	13-Apr-04
59)	SVE System Operation on Continuous Schedule	13-Apr-04	11-May-04
60)	SVE System Shut Down Due to System Vibrations	11-May-04	19-May-04
61)	SVE System Operation on Continuous Schedule	19-May-04	11-Jun-04
62)	SVE System Shut Down for Rebound Testing	11-Jun-04	13-Jul-04
63)	SVE System Operational on Continuous Schedule	13-Jul-04	13-Aug-04

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	Event	Start Date	End Date
64)	SVE System Shut Down for Rebound Testing at Site 11, Site 7 Third and Fourth Quarter Landfill Monitoring, and to Evaluate Conversion to Bioventing at Site 7/11	13-Aug-04	28-Dec-04
65)	SVE System Diagonosed with Faulty Thermal Couple, Motor Conductor, Secondary Thermal Couple. Repairs Being	28-Dec-04	25-Jan-05
66)	Optimal Operating Schedule Testing Being Performed	25-Jan-05	8-Mar-05
67)	SVE System Operation Cycled (4 days off, 3 days on)	8-Mar-05	8-Jun-05
68)	SVE System Shut Down for Respiration Testing	8-Jun-05	6-Jul-05
69)	SVE System Operation Cycled (4 days off, 3 days on)	6-Jul-05	25-Aug-05
70)	SVE System Shut Down for 3rd Quarter Landfill Monitoring	25-Aug-05	8-Sep-05
71)	SVE System Operation Cycled (4 days off, 3 days on)	8-Sep-05	13-Sep-05
72)	SVE System Shut Down for Respiration Testing	13-Sep-05	26-Sep-05
73)	SVE System Operation Cycled (4 days off, 3 days on)	26-Sep-05	4-Nov-05
74)	SVE System Shut Down for 4th Quarter Landfill Monitoring	4-Nov-05	14-Nov-05
75)	SVE System Operation Cycled (4 days off, 3 days on)	14-Nov-05	30-Dec-05
76)	SVE System Shut Down for Rebound Testing	30-Dec-05	6-Feb-06
77)	SVE System Operation Cycled (4 days off, 3 days on)	6-Feb-06	16-Mar-06
78)	SVE System Shut Down for System Evaluation (Evaluation samples collected Oct-06)	16-Mar-06	31-Dec-06
79)	SVE System Shut Down for System Evaluation and Biovent System Maintenance (Maintenance performed 6-Apr-07)	31-Dec-06	10-Apr-07
80)	Biovent System Operation Begins (1,200-cfm blower)	10-Apr-07	8-May-07
81)	Biovent System Shut Down for Well Network Reconfiguration	8-May-07	15-May-07
82)	Biovent System Operational	15-May-07	23-May-07
83)	Biovent System Shut Down due to Clogged Air Filters	23-May-07	1-Jun-07

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Event	Start Date	End Date
84) Biovent System Operational	1-Jun-07	3-Jul-07
85) Biovent System Shut Down for Rebound, Blower Maintenance	3-Jul-07	13-Jul-07
86) Biovent System Operational	13-Jul-07	22-Jul-07
87) Biovent System Shut Down for High Vacuum Alarm	22-Jul-07	26-Jul-07
88) Biovent System Operational	26-Jul-07	3-Aug-07
89) Biovent System Shut Down for Rebound Testing	3-Aug-07	8-Aug-07
90) Biovent System Operational	8-Aug-07	23-Aug-07
91) Biovent System Shut Down due to a Leaky Gasket	23-Aug-07	6-Sep-07
92) Replaced Gasket, System not Restarted	6-Sep-07	11-Sep-07
93) Biovent System Operational	11-Sep-07	27-Sep-07
94) Biovent System Shut Down for Rebound, Drilling Activities, and Landfill Cap Regrading	27-Sep-07	12-Feb-08
95) Biovent System Operational	12-Feb-08	30-May-08
96) Biovent System Shut Down for Blower Maintenance	30-May-08	2-Jun-08
97) Biovent System Operational	2-Jun-08	8-Aug-08
98) Biovent System Shut Down for Rebound Testing	8-Aug-08	4-Nov-08
99) Biovent System Operational	4-Nov-08	8-Dec-08
100) Biovent System Shut Down for Maintenance Repairs	8-Dec-08	10-Dec-08
101) Biovent System Operational	10-Dec-08	5-May-09
102) Biovent System Shut Down for Rebound Testing and Respiration Monitoring	5-May-09	6-Aug-09
103) Biovent Discontinued	6-Aug-09	31-Dec-10

Notes:
SVE - soil vapor extraction
SMAQMD - Sacramento Metropolitan Air Quality Managment District

TABLE 2

OPERATIONAL AND REMEDIAL HISTORY
SITE ST-37/ST-39/SS-54 SVE/BIOVENTSYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
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	Event	Start Date	End Date
1)	Construction Bids and Procurement	15-Sep-97	3-Oct-97
2)	Well Drilling and Installation	20-Oct-97	2-Feb-98
3)	SVE System Pilot Test	16-Feb-98	31-Mar-98
4)	Mobilization of Equipment	29-Jun-98	29-Jun-98
5)	SVE System Installation	20-Jul-98	9-Dec-98
6)	SVE System Startup and Testing	9-Dec-98	28-May-99
7)	SVE System Operation	29-May-99	15-Sep-99
8)	SVE System Temporary Shutdown	16-Sep-99	14-Nov-99
9)	SVE System Operation	15-Nov-99	7-Dec-99
10)	SVE System Shut Down for Pulsing Test	8-Dec-99	12-Dec-99
11)	SVE System Operation	13-Dec-99	3-Mar-00
12)	SVE System Shut Down for Blower Motor Repair	3-Mar-00	30-Apr-00
13)	SVE System Operation	1-May-00	2-May-00
14)	SVE System Shut Down to Conduct Rebound Testing	3-May-00	22-May-00
15)	SVE System Operation	23-May-00	27-Jun-00
16)	SVE System Shut Down to Support Site 35/36 Respiration Test	28-Jun-00	12-Jul-00
17)	SVE System Operation	12-Jul-00	18-Jul-00
18)	SVE System Shut Down to Evaluate Cycling Schedule	18-Jul-00	31-Jul-00
19)	SVE System Operation Cycled (4 days on, 3 days off)	31-Jul-00	5-Dec-00
20)	SVE System Shut Down to Conduct Rebound Testing	5-Dec-00	19-Dec-00
21)	SVE System Operation Cycled (4 days on, 3 days off)	19-Dec-00	15-Jan-01
22)	SVE System Shut Down for Long-Term Rebound Testing	15-Jan-01	16-Mar-01
23)	SVE System Operation (4 days on, 3 days off)	16-Mar-01	27-Sep-01
24)	SVE System Shut Down for SMAQMD Substantive Requirement	27-Sep-01	14-Nov-01
25)	SVE System Operation Cycled (4 days on, 3 days off)	14-Nov-01	26-Feb-02
26)	SVE System Shut Down for SMAQMD Substantive Requirement Compliance Issue (Rebound test Conducted)	26-Feb-02	18-Mar-02
27)	SMAQMD Grants MWH Permission to Restart SVE System	8-Mar-02	8-Mar-02
28)	SVE System Operation Cycled (4 days on, 3 days off)	18-Mar-02	29-Mar-02
29)	SVE System Shut Down to Conduct Rebound Testing	29-Mar-02	28-Jun-02

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OPERATIONAL AND REMEDIAL HISTORY
SITE ST-37/ST-39/SS-54 SVE/BIOVENTSYSTEM
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	Event	Start Date	End Date
30)	SMAQMD Amended the Original Substantive Requirement on April 10, 2002, to Include New Air Emission Requirements of Less Than 10 lbs/day of ROC or Controlled by 95% or Greater Destruction	10-Apr-02	10-Apr-02
31)	SVE System Operation Cycled (4 days on, 3 days off)	28-Jun-02	6-Sep-02
32)	SVE System Shut Down for SMAQMD Substantive Requirement Compliance Issue	6-Sep-02	13-Sep-02
33)	SVE System Operation Cycled (4 days on, 3 days off)	13-Sep-02	7-Oct-02
34)	SVE System Shut Down to Conduct Rebound Testing	7-Oct-02	22-Oct-02
35)	SVE System Operation Cycled (4 days on, 3 days off)	22-Oct-02	8-Nov-02
36)	SVE System Shut Down to Conduct Rebound Test	8-Nov-02	12-Dec-02
37)	SVE System Operation Cycled (4 days on, 3 days off)	12-Dec-02	6-Jan-03
38)	SVE System Operation Cycle Changed (3 days on, 4 days off)	6-Jan-03	23-May-03
39)	SVE System Shut Down to Conduct Rebound Testing	23-May-03	30-Jun-03
40)	SVE System Operation Cycle Changed (3 days on, 4 days off)	30-Jun-03	25-Aug-03
41)	SVE System Operating on Continuous Schedule	25-Aug-03	17-Oct-03
42)	SVE System Shut Down to Perform System Blower and Motor Repairs and for Rebound Testing	17-Oct-03	23-Mar-04
43)	SVE System Operating on Continuous Schedule	23-Mar-04	5-Apr-04
44)	SVE System Shut Down to Perform System Adjustments and	5-Apr-04	9-Apr-04
45)	SVE System Operating on Continuous Schedule	9-Apr-04	15-Jun-04
46)	SVE System Shut Down to Conduct Rebound Testing	15-Jun-04	22-Jul-04
47)	SVE System Operational on Continuous Schedule	22-Jul-04	4-Aug-04
48)	System Shut Down Due to July Compliance Results	4-Aug-04	16-Aug-04
49)	SVE System Operational on Continuous Schedule	16-Aug-04	5-Oct-04
50)	System Shut Down Due to September Compliance Results and for Rebound Testing	5-Oct-04	3-Dec-04
51)	SVE System Operational on Continuous Schedule	3-Dec-04	21-Jan-05
52)	SVE System Shut Down for System Troubleshooting	21-Jan-05	28-Jan-05
53)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	28-Jan-05	13-Mar-05
54)	SVE System Shut Down to Conduct Rebound Testing	13-Mar-05	4-Apr-05
55)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	4-Apr-05	27-May-05

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OPERATIONAL AND REMEDIAL HISTORY
SITE ST-37/ST-39/SS-54 SVE/BIOVENTSYSTEM
FORMER MATHER AIR FORCE BASE
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	Event	Start Date	End Date
56)	SVE System Shut Down to Conduct Rebound Testing	27-May-05	20-Jun-05
57)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	20-Jun-05	27-Jul-05
58)	SVE System Shut Down due to a Failed Gas Valve	27-Jul-05	1-Aug-05
59)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	1-Aug-05	5-Aug-05
60)	System Shut Down for Long-Term Rebound Testing and for the Soil and Soil Gas Survey	5-Aug-05	7-Dec-05
61)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	7-Dec-05	12-Dec-05
62)	SVE System Shut Down due to AWS Tank Pump Failure	12-Dec-05	15-Dec-05
63)	SVE System Operating Continuously for Testing at Site 29/71	15-Dec-05	30-Dec-05
64)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	30-Dec-05	13-Jan-06
65)	SVE System Shut Down Due to Poor Destruction Efficiency (New system purchased third quarter 2006, which arrived December 2006)	13-Jan-06	31-Dec-06
66)	SVE System Shut Down - New Soil Therm SVE System Set up	31-Dec-06	12-Feb-07
67)	SVE System Operating (500-scfm thermal oxidizer)	12-Feb-07	18-Mar-07
68)	SVE System Operating Intermittently due to Gas Pressure Adjustm	18-Mar-07	23-Mar-07
69)	SVE System Operational	23-Mar-07	27-Mar-07
70)	SVE System Shut Down for Maintence	27-Mar-07	28-Apr-07
71)	SVE System Operational	28-Apr-07	3-Jul-07
72)	SVE System Shut Down for Maintence	3-Jul-07	16-Jul-07
73)	SVE System Operating Intermittently due to a Leak in the Natural Gas Line	16-Jul-07	19-Jul-07
74)	SVE System Operational	19-Jul-07	29-Aug-07
75)	SVE System Shut Down for Modification and Replacement of the Sytem's Exhaust Stack	29-Aug-07	31-Aug-07
76)	SVE System Operational	31-Aug-07	27-Dec-07
77)	SVE System Shut Down for Rebound and Drilling Activities	27-Dec-07	11-Mar-08
78)	Vacuum Pressure Influence Testing Performed at Site 29/71 SVE Wells (29-PW-04, -05, -06)	11-Mar-08	12-Mar-08
79)	SVE System Shut Down after Vacuum Pressure Influence Testing at Site 29/71	12-Mar-08	20-Mar-08
80)	Vacuum Pressure Influence Testing Performed on Shallow SVE Wells (29-PW-04, -05, -06)	20-Mar-08	20-Mar-08

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OPERATIONAL AND REMEDIAL HISTORY
SITE ST-37/ST-39/SS-54 SVE/BIOVENTSYSTEM
FORMER MATHER AIR FORCE BASE
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	Event	Start Date	End Date
81)	SVE System Shut Down after Vacuum Pressure Influence Testing at Site 29/71	20-Mar-08	4-Apr-08
82)	Restart SVE System to Collect Compliance Samples	4-Apr-08	4-Apr-08
83)	SVE System ShutDown after Compliance Sampling	4-Apr-08	8-Apr-08
84)	SVE System Operational	8-Apr-08	1-May-08
85)	SVE System Shut Down due to Flame-out Alarm (Insuffiecent	1-May-08	2-May-08
86)	SVE System Operational	2-May-08	5-May-08
87)	SVE System Shut Down due to Flame-out Alarm (Insuffiecent	5-May-08	7-May-08
88)	SVE System Operational	7-May-08	7-May-08
89)	SVE System Shut Down due to Flame-out Alarm (Insuffiecent	7-May-08	9-May-08
90)	SVE System Operational	9-May-08	9-May-08
91)	SVE System Shut Down due to Flame-out Alarm (Insuffiecent	9-May-08	12-May-08
92)	SVE System Operational	12-May-08	15-May-08
93)	SVE System Shut Down due to Flame-out Alarm (Insuffiecent	15-May-08	16-May-08
94)	SVE System Operational	16-May-08	28-May-08
95)	SVE System Shut Down due to Flame-out Alarm (Insuffiecent	28-May-08	2-Jun-08
96)	SVE System Operational	2-Jun-08	4-Jun-08
97)	SVE System Shut Down due to Flame-out Alarm (Insuffiecent	4-Jun-08	6-Jun-08
98)	SVE System Operational	6-Jun-08	16-Jun-08
99)	SVE System Shut Down for Instrument Calibrations	16-Jun-08	17-Jun-08
100)	SVE System Operational	17-Jun-08	5-Jul-08
101)	SVE System Shut Down for Well Field Maintenance at Site 29/71	5-Jul-08	23-Jul-08
102)	SVE System Operational	23-Jul-08	24-Jul-08
103)	SVE System Shut Down for Rebound	24-Jul-08	12-Nov-08
104)	SVE System Operational	12-Nov-08	5-Dec-08
105)	SVE System Shut Down for Vacuum Pressure Influence Testing	5-Dec-08	5-Dec-08
106)	SVE System Operational only with SVE Site 29/71 Wells	5-Dec-08	28-May-09
107)	SVE System Shut Down for Rebound	28-May-09	15-Jul-09
108)	SVE System Operational	15-Jul-09	5-Oct-09

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OPERATIONAL AND REMEDIAL HISTORY
SITE ST-37/ST-39/SS-54 SVE/BIOVENTSYSTEM
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Event	Start Date	End Date
109) SVE System Operational only with SVE Site 37/39/54 Wells	5-Oct-09	31-Dec-09
110) SVE System Operational only with SVE Site 37/39/54 Wells	31-Dec-09	21-Jan-10
111) SVE System Offline	21-Jan-10	13-Oct-10
112) SVE System reconfigured for bioventing (BV) (air injection). BV System operational.	13-Oct-10	31-Dec-10
113) BV System Operational	1-Jan-11	23-Mar-11
114) Power Outage	23-Mar-11	24-Mar-11
115) BV System Operational	24-Mar-11	18-Jul-11
116) BV System Shut Down for Rebound	18-Jul-11	31-Dec-11
117) BV System Operational	1-Jan-12	9-Feb-12
118) Increased air flow to all site wells	9-Feb-12	7-Mar-12
119) Shutdown system to repair break in piping at site 29	7-Mar-12	8-Mar-12
120) BV System Operational	8-Mar-12	20-Mar-12
121) Shutdown system to attach 37-PW-03 to the system	20-Mar-12	21-Mar-12
122) Restart system without the South leg of Site 37 (39-SVE-01C, 37-PW-03, 37-PW-06)	21-Mar-12	23-May-12
123) Shutdown system to repair break	23-May-12	23-May-12
124) BV System Operational	23-May-12	29-Jun-12
125) Restarted South leg of Site 37	2-Apr-12	29-Jun-12
126) Shutdown for rebound	29-Jun-12	22-Feb-13
127) SVE System Operational	22-Feb-13	14-Oct-13
128) Power Outage	14-Oct-13	17-Oct-13
129) SVE System Operational	17-Oct-13	18-Dec-13
130) System Shut Down for Respiration and Rebound Testing	18-Dec-13	

Notes:
AWS - air water separator
BV - biovent/bioventing
lbs/day - pounds per day
MWH - MWH Americas, Inc.
ROC -reactive organic compound
SMAQMD - Sacramento Metropolitan Air Quality Management District
SVE - soil vapor extraction

TABLE 3

OPERATIONAL AND REMEDIAL HISTORY
SITE SD-57 SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 1 of 4)

	Event	Start Date	End Date
1)	Notice to Proceed	17-Mar-97	-----
2)	Mobilization of Equipment	2-Mar-97	6-Mar-97
3)	Well Drilling Program (Phase I)	17-Mar-97	28-Mar-97
4)	Pilot Test	3-Apr-97	4-Apr-97
5)	SVE System Installation (Phase I)	7-May-97	15-Aug-97
6)	SVE System Startup and Proveout	19-Aug-97	17-Oct-97
7)	SVE System Operation (Catalytic Mode)	17-Oct-97	12-Jan-98
8)	Rebound Test Conducted	12-Jan-98	20-Feb-98
9)	Installed four Monitoring Points (Phase II): MPMP-4 through MPMP-7	11-Mar-98	1-Apr-98
10)	SVE System Shut Down when Vapor Cooling Water Backflushed into the Burner	17-Jul-98	3-Sep-98
11)	SVE System Operation (Catalytic Mode)	3-Sep-98	10-Dec-98
12)	Installed One Monitoring Point (Phase III): MPMP-8	1-Dec-98	2-Dec-98
13)	SVE System Shut Down, Electrical Problems	11-Dec-98	28-Feb-99
14)	SVE System Operation (Catalytic Mode)	1-Mar-99	15-Apr-99
15)	SVE System Shut Down, Troubleshooting	16-Apr-99	13-May-99
16)	SVE System Operation (Catalytic Mode)	14-May-99	30-Jun-99
17)	SVE System Shut Down for Operation Study by Praxis	14-Jul-99	30-Jul-99
18)	SVE System Operation (Catalytic Mode)	2-Aug-99	5-Oct-99
19)	SVE System Shut Down for Converting to GAC Mode	6-Oct-99	1-Nov-99
20)	SVE System Operation (GAC Mode)	2-Nov-99	22-Jul-00
21)	SVE System Shut Down for Rebound Study and Concurrent Warranty Repairs	22-Jul-00	1-Nov-00
22)	SVE System Operation (GAC Mode)	1-Nov-00	3-Feb-01
23)	SVE System Shut Down for Rebound Study and Concurrent Warranty Repairs	3-Feb-01	30-Mar-01
24)	SVE System Operation (GAC Mode)	30-Mar-01	17-Apr-01
25)	SVE System Shut Down for Sound Enclosure Construction	17-Apr-01	23-Apr-01

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OPERATIONAL AND REMEDIAL HISTORY
SITE SD-57 SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
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	Event	Start Date	End Date
26)	SVE System Operation (GAC Mode)	23-Apr-01	14-Sep-01
27)	SVE System Shut Down for Dual Phase Extraction Activities	14-Sep-01	18-Sep-01
28)	SVE System Operation (GAC Mode)	18-Sep-01	27-Sep-01
29)	SVE System Shut Down for Dual Phase Extraction Activities	27-Sep-01	1-Oct-01
30)	SVE System Operation (GAC Mode)	1-Oct-01	9-Jul-03
31)	SVE System Shut Down for System Blower Repairs	9-Jul-03	20-Aug-03
32)	SVE System Operation (GAC Mode)	20-Aug-03	30-Dec-03
33)	SVE System Shut Down SMAQMD Compliance Issue and to Perform a Rebound Test	30-Dec-03	8-Mar-04
34)	SVE System Operation (GAC no longer required, permission granted by SMAQMD 19 February 2004)	8-Mar-04	14-Jun-04
35)	SVE System Shut Down for Rebound Testing	14-Jun-04	12-Jul-04
36)	System Operational on Continuous Schedule	12-Jul-04	10-Dec-04
37)	System Shut Down to Perform Rebound Testing	10-Dec-04	4-Jan-05
38)	System Operational on Continuous Schedule	4-Jan-05	20-Apr-05
39)	SVE System Shut Down for 57-SVE-7A Tie-in	20-Apr-05	21-Apr-05
40)	System Operational on Continuous Schedule	21-Apr-05	3-Aug-05
41)	Installed One Multi-probe Monitoring Well	16-May-05	17-May-05
42)	57-SVE-7A brought Online to SVE System	18-May-05	18-May-05
43)	System Shut Down to Replace Blower Belt, for Long-Term Rebound Testing, and for the Soil and Soil Gas Survey	3-Aug-05	6-Dec-05
44)	System Operational on Continuous Schedule	6-Dec-05	8-Dec-05
45)	System Shut Down for Compliance Issue	8-Dec-05	28-Apr-06
46)	System Operational on Continuous Schedule	28-Apr-06	24-May-06
47)	System Shut Down awating Compliance Sample Results	24-May-06	5-Jun-06
48)	System Operational on Continuous Schedule	5-Jun-06	12-Jun-06
49)	System Shut Down awating Compliance Sample Results	12-Jun-06	30-Jun-06
50)	System Operational on Continuous Schedule	30-Jun-06	5-Oct-06
51)	System Shut Down for Rebound Testing	6-Oct-06	13-Dec-06

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OPERATIONAL AND REMEDIAL HISTORY
SITE SD-57 SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
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	Event	Start Date	End Date
52)	System Operational Intermittently for Radius of Influence Testing	13-Dec-06	15-Dec-06
53)	System Shut Down for System Evaluation	15-Dec-06	4-Jan-07
54)	System Restarted and Operational on Continuous Schedule	4-Jan-07	14-Jan-07
55)	System Shut Down Due to High AWS Discharge Water Levels	14-Jan-07	16-Jan-07
56)	System Restarted and Operational on Continuous Schedule	16-Jan-07	19-Jan-07
57)	System Shut Down Due to High AWS Discharge Water Levels	19-Jan-07	22-Jan-07
58)	System Restarted and Operational on Continuous Schedule	22-Jan-07	26-Jan-07
59)	System Shut Down Due to High AWS Discharge Water Levels and Waiting for Carbon	26-Jan-07	5-Mar-07
60)	System Restarted and Operational on Continuous Schedule	5-Mar-07	9-Jul-07
61)	System Shut Down Due to Blower Motor Failure	9-Jul-07	31-Jul-07
62)	System Restarted and Operational on Continuous Schedule	31-Jul-07	17-Aug-07
63)	System Shut Down Due to Low Air Flow at the System's Blow	17-Aug-07	21-Aug-07
64)	System Restarted and Operational on Continuous Schedule	21-Aug-07	8-Oct-07
65)	System Shut Down for Rebound and Drilling Activities	8-Oct-07	19-Feb-08
66)	System Restarted for Compliance Sampling	19-Feb-08	19-Feb-08
67)	System Shut Down after Compliance Sampling	19-Feb-08	25-Feb-08
68)	SVE System Operational	25-Feb-08	5-Aug-08
69)	System Shut Down for Rebound, Connection of 57-PW-01 and 57-PW-02 to the SVE System, and Replacement of Water-to-Air Heat Exchanger with Air-to-Air Heat Exchanger	5-Aug-08	1-Oct-08
70)	SVE System Operational with GAC	1-Oct-08	2-Dec-08
71)	System Shutdown due to Failed Blower and Motor	2-Dec-08	25-Feb-09
72)	System Offline for Air Emissions Compliance Verification	25-Feb-09	16-Mar-09
73)	SVE System Operational without GAC	16-Mar-09	27-May-09
74)	SVE System Shutdown for Rebound	27-May-09	15-Jul-09
75)	SVE System Operational without GAC	15-Jul-09	22-Jan-10
76)	SVE System Offline	22-Jan-10	6-Dec-11
77)	SVE System Operational with GAC	6-Dec-11	28-Dec-11

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OPERATIONAL AND REMEDIAL HISTORY
SITE SD-57 SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
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	Event	Start Date	End Date
78)	SVE System Operational without GAC	28-Dec-11	21-Jan-12
79)	System shutdown due to high AWS tank level	21-Jan-12	23-Jan-12
80)	Restarted system	23-Jan-12	31-Jan-12
81)	Shutdown system for 1 hour to replace AWS flowmeter	31-Jan-12	31-Jan-12
82)	Restarted system	31-Jan-12	17-Mar-12
83)	System shutdown due to High AWS tank level	17-Mar-12	21-Mar-12
84)	Restarted system	21-Mar-12	13-Apr-12
85)	Shutdown due to High AWS tank	13-Apr-12	13-Apr-12
86)	Restarted system	13-Apr-12	29-Jun-12
87)	System Shut Down for Rebound Testing	29-Jun-12	10-Jan-13
88)	Restarted system	10-Jan-13	11-Jan-13
89)	Shutdown to preform repairs	11-Jan-13	11-Jan-13
90)	Restarted system	11-Jan-13	17-Jan-13
91)	Shutdown due to High AWS	17-Jan-13	21-Jan-13
92)	Restarted system	21-Jan-13	29-Jan-13
93)	Shutdown due to High AWS	29-Jan-13	29-Jan-13
94)	Restarted system	29-Jan-13	31-Jan-13
95)	Shutdown due to High AWS	31-Jan-13	4-Feb-13
96)	Restarted system	4-Feb-13	14-Apr-13
97)	Shut down until new heat exchanger motor installed	14-Apr-13	1-May-13
98)	Restarted system with new motor	1-May-13	3-May-13
99)	Shut down, system heat exhanger fan broken	3-May-13	6-May-13
100)	Restarted system with new fan	6-May-13	10-Jun-13
101)	Bypassed carbon unit	10-Jun-13	30-Jul-13
102)	System Shut Down for Rebound Testing	30-Jul-13	31-Dec-13

Notes:
AWS - air water separator
GAC - granular activated carbon
SMAQMD - Sacramento Metropolitan Air Quality Management District
SVE - soil vapor extraction

TABLE 4

OPERATIONAL AND REMEDIAL HISTORY
SITE SD-59 SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

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	Event	Start Date	End Date
1)	First Phase SVE Well & SVMP Drilling Program	14-Oct-98	6-Nov-98
2)	Pilot Test	10-Dec-98	16-Dec-98
3)	Second Phase SVE Well & SVMP Drilling Program	10-Jun-99	7-Jul-99
4)	SVE System Installation	27-Oct-99	1-Nov-99
5)	Utility Installation	2-Nov-99	21-Jan-99
6)	SVE System Startup and Proveout	8-Feb-00	16-Aug-00
7)	SVE System Operation (Catalytic Oxidation Mode)	16-Aug-00	13-Oct-00
8)	System Shut Down as a Result of Scrubber Problems	13-Oct-00	14-Dec-00
9)	SVE System Operation (Catalytic Oxidation Mode)	14-Dec-00	3-Feb-01
10)	System Shut Down as a Result of Scrubber Problems	3-Feb-01	20-Feb-01
11)	SVE System Operation (Catalytic Oxidation Mode)	20-Feb-01	18-Jun-01
12)	System Shut Down for Long-Term Rebound Test	18-Jun-01	26-Oct-01
13)	Catalytic Oxidizer Removed from Service. Soil Vapor Re-routed to the Site 18 SVE GAC System	2-Aug-01	2-Aug-01
14)	SVE System (GAC Mode) Operational, Cycled Operation Beginning 2/8/02	26-Oct-01	18-Jun-02
15)	SVE System Shutdown for Rebound Test	18-Jun-02	28-Jun-02
16)	SVE System Operation (GAC Mode) cycled (4 days on, 3 days off)	28-Jun-02	16-Nov-02
17)	SVE System Shut Down for Rebound Test	16-Nov-02	2-Dec-02
18)	SVE System Operation cycled (4 days on, 3 days off)	2-Dec-02	31-Dec-02
19)	SVE System Operation Cycle Changed (3 days on, 4 days off)	1-Jan-03	23-May-03
20)	SVE Cat-OX System Removed for Use at Castle AFB	21-Mar-03	21-Mar-03
21)	SVE System Shut Down for Rebound Test	23-May-03	30-Jun-03
22)	SVE System Operation Cycle Changed (3 days on, 4 days off)	30-Jun-03	17-Jul-03
23)	SVE System Shut Down for Rebound Test	17-Jul-03	22-Aug-03

TABLE 4

OPERATIONAL AND REMEDIAL HISTORY
SITE SD-59 SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

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	Event	Start Date	End Date
24)	SVE System Operating on Continuos Schedule	22-Aug-03	5-Dec-03
25)	SVE System Shut Down for Rebound Test	5-Dec-03	9-Mar-04
26)	SVE System Operating on Continuos Schedule	9-Mar-04	23-Mar-04
27)	SVE System Shut Down to Repair Blower	23-Mar-04	31-Mar-04
28)	SVE System Operating on Continuous Schedule	31-Mar-04	2-Apr-04
29)	SVE System Shut Down Due to System Electrical Problem	2-Apr-04	8-Apr-04
30)	SVE System Operating on Continuous Schedule	8-Apr-04	16-Apr-04
31)	SVE System Shut Down to Perform Pilot Study at Site 59, Addition of MAFB-105.	16-Apr-04	19-Apr-04
32)	SVE System with GAC Operational on Continuous Schedule	19-Apr-04	17-May-04
33)	SVE System Shut Down for Drilling and Installation of Additional Vadose Zone Wells at Site 59	17-May-04	16-Jun-04
34)	Site 59 Rebound Testing, Tie-in Newly Installed SVE Wells to SVE System, Perform System Carbon Changeout	16-Jun-04	31-Aug-04
35)	SVE System with GAC Operational on Continuous Schedule	31-Aug-04	3-Sep-04
36)	System Shut Down to Await Results from Confirmation Compliance Sample Collected on 9/3/04	3-Sep-04	13-Sep-04
37)	SVE System with no GAC Operational on Continuous Schedule. GAC removed based on substantive requirements met according to SMAQMD.	13-Sep-04	15-Oct-04
38)	System Shut Down because Field Readings from October Compliance Sample Indicated System Not Operating Properly	15-Oct-04	29-Oct-04
39)	SVE System Operational with GAC on Continuous Schedule	29-Oct-04	29-Nov-04
40)	SVE System Shut Down Due to Broken System Blower Belt	29-Nov-04	2-Dec-04
41)	SVE System Operational with GAC on Continuous Schedule	2-Dec-04	3-Dec-04

TABLE 4

OPERATIONAL AND REMEDIAL HISTORY
SITE SD-59 SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

(Page 3 of 5)

	Event	Start Date	End Date
42)	SVE System to Perform Repairs to System Blower	3-Dec-04	4-Jan-05
43)	SVE System Operational with GAC on Continuous Schedule	4-Jan-05	30-Jan-05
44)	SVE System Shut Down due to High AWS Discharge Tank	30-Jan-05	3-Feb-05
45)	SVE System Operational with GAC on Continuous Schedule	3-Feb-05	3-Mar-05
46)	SVE System Shut Down for Rebound Test	3-Mar-05	2-May-05
47)	SVE System Operational with GAC on Continuous Schedule	2-May-05	20-Jun-05
48)	System Shut Down due to Water Line Tie-in	20-Jun-05	24-Jun-05
49)	SVE System Operational with GAC on Continuous Schedule	24-Jun-05	1-Aug-05
50)	System Shut Down for Long-Term Rebound Testing and for the	1-Aug-05	28-Feb-06
51)	SVE System Operational on Continuous Schedule; GAC Abatement Removed (Numerous shutdowns due to High AWS Discharge Tank)	28-Feb-06	28-Apr-06
52)	SVE System Operational	28-Apr-06	5-Oct-06
53)	SVE Shut Down for Rebound Testing	5-Oct-06	8-Dec-06
54)	SVE System Restarted for Radius of Influence Testing	8-Dec-06	11-Dec-06
55)	SVE System Shut Down for System Evaluation	11-Dec-06	1-Jan-07
56)	SVE System Operational	1-Jan-07	15-Jan-07
57)	SVE System Shut Down due to High AWS Discharge Tank	15-Jan-07	17-Jan-07
58)	SVE System Operational	17-Jan-07	15-Mar-07
59)	SVE System Operational; Vapor Extraction Well 18-SVE-004	15-Mar-07	17-Mar-07
60)	SVE System Operational	17-Mar-07	8-Oct-07
61)	SVE System Shut Down for Rebound and Drilling Activities at Site 59	8-Oct-07	9-Apr-08
62)	SVE System Operational	9-Apr-08	5-Jun-08
63)	SVE System Shut Down for Utility Service Interruption	5-Jun-08	9-Jun-08
64)	SVE System Operational	9-Jun-08	4-Aug-08

TABLE 4

OPERATIONAL AND REMEDIAL HISTORY
SITE SD-59 SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

(Page 4 of 5)

	Event	Start Date	End Date
65)	Performed Pilot Vacuum Extraction Test at 59-PW-02	4-Aug-08	4-Aug-08
66)	SVE System Operational	4-Aug-08	15-Aug-08
67)	SVE System Shut Down for Rebound	15-Aug-08	1-Oct-08
68)	SVE System Operational	1-Oct-08	12-Nov-08
69)	SVE System Shut Down for AWS Pump and Heat Exchanger Replacement	12-Nov-08	9-Jan-09
70)	SVE System Operational with New Heat Exchanger	9-Jan-09	12-Jan-09
71)	SVE System Shut Down as Blower and Motor Failed	12-Jan-09	22-Jul-09
72)	SVE System Operational after Replacement of Blower and Motor	22-Jul-09	25-Aug-09
73)	SVE System Shut Down for Drilling Activities at the Site	25-Aug-09	9-Dec-09
74)	SVE System Operational	9-Dec-09	29-Jan-10
75)	SVE System Shut Down for Rebound Sampling	29-Jan-10	18-Nov-10
76)	SVE System Operational	18-Nov-10	31-Dec-10
77)	Shut Down for Rebound Sampling	30-Jun-11	6-Dec-11
78)	Down for Additional wells to be added to the System	6-Dec-11	31-Dec-11
79)	Down for new pipeline to be installed	1-Jan-12	13-Mar-12
80)	SVE System Operational with VGAC	13-Mar-12	19-Mar-12
81)	Est. time: Belts broke and system stopped treating	19-Mar-12	22-Mar-12
82)	Replaced belts and restarted the system	22-Mar-12	4-May-12
83)	System shutdown due to high SVE Temp	4-May-12	10-May-12
84)	SVE System Operational with VGAC	10-May-12	28-Jun-12
85)	Shut Down for Rebound Sampling	28-Jun-12	9-Feb-13
86)	SVE System Operational with VGAC	9-Feb-13	28-Feb-13
87)	SVE System Shut Down due to High AWS Alarm	28-Feb-13	1-Mar-13

TABLE 4

OPERATIONAL AND REMEDIAL HISTORY
SITE SD-59 SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

(Page 5 of 5)

Event		Start Date	End Date
88)	SVE System Operational with VGAC	1-Mar-13	18-Apr-13
89)	Shut down the system to clean out filters	18-Apr-13	29-Apr-13
90)	SVE System Operational with VGAC	29-Apr-13	3-May-13
91)	System shut down	3-May-13	6-May-13
92)	SVE System Operational with VGAC	6-May-13	3-Jun-13
93)	System shutdown electrical issue	3-Jun-13	4-Jun-13
94)	SVE System Operational with VGAC	4-Jun-13	10-Jun-13
95)	Bypassed carbon (VGAC) unit	10-Jun-13	30-Jul-13
96)	Shut Down for Rebound Sampling	30-Jul-13	31-Dec-13

Notes:
AWS - air water separator
VGAC - vapor-phase granular activated carbon
SVE - soil vapor extraction
SVMP - soil vapor monitoring point

TABLE 5

OPERATIONAL AND REMEDIAL HISTORY
SITE OT-23C SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 1 of 4)

	Event	Start Date	End Date
1)	First Phase SVMP Drilling Program	19-Oct-98	13-Nov-98
2)	First Phase SVE Well Drilling Program	4-Jan-99	12-Jan-99
3)	Second Phase SVE Well & SVMP Drilling Program	23-Jun-99	20-Jul-99
4)	SVE System Installation	25-Oct-99	25-Feb-00
5)	Utility Installation	28-Feb-00	29-Mar-00
6)	CAT-OX System Startup and Proveout	12-Apr-00	28-Aug-00
7)	SVE System Operation	28-Aug-00	28-Nov-00
8)	System Shut Down Due to Water Accumulation in the Conveyance Piping	28-Nov-00	23-Jan-01
9)	SVE System Operation	23-Jan-01	18-Mar-01
10)	SVE Shut Down Due to Mechanical Problems	18-Mar-01	26-Mar-01
11)	SVE System Operation	26-Mar-01	1-Apr-01
12)	SVE Shut Down for Sound Insulation Installation	1-Apr-01	5-Apr-01
13)	SVE System Operation	5-Apr-01	24-Apr-01
14)	SVE Shut Down Due to pH Controller Problems	24-Apr-01	15-May-01
15)	SVE System Operation	15-May-01	31-May-01
16)	SVE Shut Down Due to Recirculation Pump Problems	31-May-01	11-Jun-01
17)	SVE System Operation	11-Jun-01	14-Jun-01
18)	SVE Shut Down Due to pH Problems	14-Jun-01	6-Jul-01
19)	SVE Shut Down for Rebound Testing	6-Jul-01	27-Aug-01
20)	SVE System Operation	27-Aug-01	2-Sep-01
21)	SVE Shut Down Due to Throwing Blower Drive Belt	2-Sep-01	26-Sep-01
22)	SVE System Operation	26-Sep-01	8-Oct-01
23)	SVE Shut Down Due to Recirculation Pump Problems	8-Oct-01	25-Oct-01
24)	SVE System Operation	25-Oct-01	11-Nov-01
25)	SVE Shut Down Due to Scrubber Problem	11-Nov-01	15-Nov-01
26)	SVE System Operation	15-Nov-01	19-Nov-01

TABLE 5

OPERATIONAL AND REMEDIAL HISTORY
SITE OT-23C SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
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	Event	Start Date	End Date
27)	SVE Shut Down Due to Sight Glass Fouling	19-Nov-01	28-Nov-01
28)	SVE System Operation	28-Nov-01	1-Dec-01
29)	SVE Shut Down Due to Flame out problem and to clean combustion chamber	1-Dec-01	6-Dec-01
30)	SVE System Operation	6-Dec-01	24-Dec-01
31)	SVE Shut Down Due to Flame out problem and to clean UV sensor.	24-Dec-01	31-Dec-01
32)	SVE System Operation	31-Dec-01	28-Jan-02
33)	System Shut Down due to system conversion to GAC mode	28-Jan-02	13-Feb-02
34)	SVE System Operation	13-Feb-02	15-Mar-02
35)	SVE System Shut Down for Rebound Testing	15-Mar-02	23-Apr-02
36)	SVE System Operation	23-Apr-02	26-Mar-03
37)	SVE System Shut Down for Carbon Changeout	26-Mar-03	26-Mar-03
38)	SVE System Operation	26-Mar-03	9-Jun-03
39)	SVE Shut Down for Rebound Testing	9-Jun-03	24-Jun-03
40)	SVE System Operation	24-Jun-03	26-Nov-03
41)	SVE Shut Down due to SMAQMD Compliance Issue and for Rebound Testing	26-Nov-03	7-Jan-04
42)	SVE System Operation	7-Jan-04	17-Jun-04
43)	SVE System Shut Down for Rebound Testing	17-Jun-04	1-Jul-04
44)	SVE System Operation	1-Jul-04	17-Nov-04
45)	SVE System Shut Down for Rebound Testing	17-Nov-04	8-Dec-04
46)	SVE System Operation	8-Dec-04	2-Jun-05
47)	SVE System Shut Down for Carbon Changeout	13-Jan-05	13-Jan-05
48)	SVE System Shut Down for Rebound Testing	2-Jun-05	22-Jun-05
49)	SVE System Operation	22-Jun-05	5-Aug-05
50)	Soil Gas Survey Performed	27-Oct-05	27-Oct-05
51)	SVE System Shut Down for Long-Term Rebound Testing and for the Soil and Soil Gas Survey	5-Aug-05	4-Jan-06

TABLE 5

OPERATIONAL AND REMEDIAL HISTORY
SITE OT-23C SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 3 of 4)

Event		Start Date	End Date
52)	SVE System Operation	4-Jan-06	16-Jan-06
53)	SVE System Shut Down for System Evaluation	16-Jan-06	26-Jan-06
54)	SVE System Operation	26-Jan-06	3-Feb-06
55)	SVE System Shut Down for Carbon Changeout	3-Feb-06	3-Feb-06
56)	SVE System Operation	3-Feb-06	4-Apr-06
57)	SVE System Shut Down for System Evaluation	4-Apr-06	20-Apr-06
58)	SVE System Operation	20-Apr-06	5-Oct-06
59)	SVE Sytem Shut Down for Rebound Testing	5-Oct-06	21-Dec-06
60)	SVE System Restarted for Radius of Influence Testing	22-Dec-06	27-Dec-06
61)	SVE Sytem Shut Down for System Evaluation	28-Dec-06	31-Dec-06
62)	SVE Sytem Shut Down for System Evaluation	31-Dec-06	2-Feb-07
63)	SVE System Operation	2-Feb-07	8-Oct-07
64)	SVE System Shut Down for Rebound and Drilling Activities	8-Oct-07	2-Apr-08
65)	SVE System Operational	2-Apr-08	21-Apr-08
66)	SVE System Shut Down	21-Apr-08	1-May-08
67)	SVE System Operational	1-May-08	15-Aug-08
68)	SVE System Shut Down for Rebound	15-Aug-08	1-Oct-08
69)	SVE System Operational	1-Oct-08	25-Dec-08
70)	SVE System Shut Down for AWS Maintenance	25-Dec-08	31-Dec-08
71)	SVE System Operational	31-Dec-08	27-May-09
72)	SVE System Shut Down for Rebound, GAC change-out)	26-May-09	15-Jul-09
73)	SVE System Operational	15-Jul-09	3-Sep-09
74)	SVE System Shut Down to Replace Heat Exchanger Motor	3-Sep-09	14-Sep-09

TABLE 5

OPERATIONAL AND REMEDIAL HISTORY
SITE OT-23C SVE SYSTEM
FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
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	Event	Start Date	End Date
75)	SVE System Operational	14-Sep-09	22-Jul-10
76)	SVE System Shut Down for Rebound	22-Jul-10	19-Nov-10
77)	SVE System Operational	19-Nov-10	31-Dec-10
78)	Various Shutdowns/ Troubleshooting/Repair	1-Jan-11	10-Jan-11
79)	SVE System Operational	10-Jan-11	30-Jun-11
80)	System Down for Rebound	30-Jun-11	6-Dec-11
81)	SVE System Operational	6-Dec-11	31-Dec-11
82)	SVE System Operational	1-Jan-12	27-Apr-12
83)	Shutdown system to tighten the belts	27-Apr-12	27-Apr-12
84)	SVE System Operational	27-Apr-12	29-Jun-12
85)	System Down for Rebound	29-Jun-12	10-Jan-13
86)	SVE System Operational	10-Jan-13	25-Jul-13
87)	SVE System Shut Down, no alarms	25-Jul-13	13-Sep-13
88)	SVE System Operational	13-Sep-13	14-Oct-13
89)	SVE System Shut Down due to Power Outage	14-Oct-13	17-Oct-13
90)	SVE System Operational	17-Oct-13	23-Dec-13
91)	VGAC Change-Out	23-Dec-13	23-Dec-13
92)	SVE System Operational	23-Dec-13	31-Dec-13

Notes:
AWS - air water separator
CAT-OX - catalytic oxidizer
GAC - granular activated carbon
pH - potential hydrogen
SMAQMD - Sacramento Metropolitan Air Quality Management District
SVE - soil vapor extraction
SVMP - soil vapor monitoring point
UV - ultraviolet

APPENDIX B

Interview Records

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List of Interviewees

Former Mather Air Force Base Operations and Maintenance Representatives

1 Philip Mook, Chief, Western Region Execution Branch, Air Force Civil Engineer Center
2 Paul Bernheisel, Field Engineer, Western Region Execution Branch, Air Force Civil Engineer Center
3 Douglas Fortun, Former Base Realignment and Closure Environmental Coordinator, Western Region Execution Center, Air Force Real Property Agency
4 William Hughes, Air Force Environmental Support Contractor, Cherokee Nation Technology Solutions
5 Paul Graff, Project Manager, Former Mather AFB Performance Based Remediation Contract, URS Group, Inc.
6 George Bradshaw, Operations and Maintenance Lead Operator, Former Mather AFB Performance Based Remediation Contract, URS Group, Inc.

Community Representatives

1 Don Nottoli, County Supervisor, Sacramento County
2 Bob McGarvey, Vice-Mayor, City of Rancho Cordova
3 Clark Whitten, Deputy Director, Economic Development, Sacramento County
4 Phillip Benedetto, Mather Airport Manager, Sacramento County
5 Sandra Lunceford, Community Member and Former Restoration Advisory Board Community Co-Chair
6 Evan Jacob, External Affairs Department, California American Water Company
7 Cheryl Hawkins, Supervising Environmental Specialist, Environmental Management Division, Sacramento County
8 John Danciart, Captain, Sacramento Metropolitan Fire District
9 Lu-Anne Spencer-Hartle, Elementary Program Coordinator, Splash
10 Brenda Sylvia, Mather Sports Complex Operations Supervisor, Rancho Cordova Parks and Recreation

Former Mather AFB – Fourth Five-Year Review Interview Questionnaire

Provided by: **Date: 3/27/14**
Philip Mook
Chief, Western Execution Branch
BRAC Program Management Division, Air Force Civil Engineer Center
3411 Olson Street
McClellan CA 95652

1. **What is your overall impression of the remedies selected for the former Mather AFB's Installation Restoration Program (IRP) (e.g., excavation, SVE, groundwater extraction and treatment, landfill cap, and institutional controls)?**

Fully protective of human health and the environment.

2. **Are the remedies functioning as expected? How well are the remedies performing? Do you have any concerns regarding the function of the remedies?**

Yes.

3. **What do the groundwater and soil vapor monitoring data show? Are there any trends that show contaminant levels are decreasing?**

Overall, the trends show contaminant levels have, and continue, to decrease. There are a few examples of a monitoring well, or group of wells, having an increase in contaminant levels. I believe this is a temporal situation related to local transport of contaminants or variations in analytical methods/results and not indicative of a unknown source or a deficiency in the remedial design or operation.

4. **Have there been unexpected operation and maintenance (O&M) difficulties or costs at the former Mather AFB in the last five years? If so, please provide details.**

Not sure if this is in or out of the last 5 years, but the solar powered vent fans on one of the Mather landfills were not operational for some period of time. Their "non-operational" status was only discovered during the investigation of why unacceptable levels of methane were detected in the landfill's monitoring wells. O&M procedures were modified, and/or adhered to, to help prevent this from happening again. Human health and the environment were not jeopardized, and it's my understanding the methane excursion has not been repeated

.

5. **Has the former Mather AFB been in compliance with permitting and reporting requirements?**

   As far as I know.

6. **Has the status of institutional controls been reported as required? What type of monitoring is currently being conducted or has been conducted to determine institutional control compliance? Have any deficiencies or violations of the institutional controls occurred?**

   These questions should be separated into individual questions.

   a. Has the status of institutional controls been reported as required? I believe the short answer is: yes, the Air Force is/has done its reporting as required. DTSC and the County of Sacramento are late in executing State Land Use Covenants (SLUC) for property with environmental institutional controls. This is an administrative issue. There are many other “layers” (e.g., county ordinance on groundwater consultation zone, county property zone, engineering controls [e.g., airport/landfill fences], USA Dig Alerts, and AF’s O&M reports for gw and landfills) that monitor/report on institutional controls.

   b. What type of monitoring is currently being conducted or has been conducted to determine institutional control compliance? See response above.

   c. Have any deficiencies or violations of the institutional controls occurred? Not that I am aware of.

7. **Do you have any comments, suggestions, or recommendations regarding the implementation of the IRP remedies or how the program has been conducted in general?**

   No.

8. **Do you have any comments or recommendations about the operation of the IRP remedies related to future effectiveness or optimization of operations?**

   Not at this time. I deliver my comments and recommendations immediately, and don’t save them for a FYR cycle.

9. **What is your single greatest concern regarding the ongoing performance of the IRP remedies?**

   Not a super big deal, but DTSC and County should complete and record their SLUCs. The environmental controls are included in the Mather Records of Decision, as amended, and it should be easy to transfer them into SLUCs.

10. Have any new or emerging contaminants been identified? If so, have they impacted the effectiveness of the remedies?

Perfluorooctane sulfonate (PFOS) and perfluoroctane acid (PFOA) (aka, perflorinate compounds [PFC]) are the emerging contaminant de jour. The AF may have stored, released, or disposed of PFOS/PFOA in its use of fire fighting foam. A PFOS/PFOA preliminary assessment/site investigation (PA/SI) is underway at AF BRAC facilities. The former Mather AFB is part of this programmatic PA/SI. The results of the PA/SI will be used to determine if further CERCLA investigation/remedial activities are required.

My opinion, not based on data or an intimate knowledge of firefighting training activities at Mather, is PFOS/PFOA will not be a significant and/or protectiveness issue. First, PFOS/PFOA is a significant issue downstream of former production facilities (i.e., 3M Company). I believe AF activities resulted in many orders of magnitude less release and disposal as a production facility. Second, fire training areas at BRAC installations, including Mather, have already undergone investigations and remedial actions. Often a part of the remedial action was the removal/landfill disposal of surface soils for metals and semi-volatiles contamination. Most likely the same location for potential PFOS/PFOA contamination, and could have been collaterally remediated.

11. Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.

Yes.

Thank you for your feedback.

Former Mather AFB – Fourth Five-Year Review Interview Questionnaire

Provided by: **Date: 3/27/14**

Paul Bernheisel, GS-13, DAF
AFCEC Western Region Field Engineer
3411 Olson St.
McClellan, CA 95652
(916) 643-0830 Ext.240
(916) 997-1798 Cell

1. **What is your overall impression of the remedies selected for the former Mather AFB's Installation Restoration Program (IRP) (e.g., excavation, SVE, groundwater extraction and treatment, landfill cap, and institutional controls)?**

My overall impression of the remedies selected for the former Mather AFB Installation Restoration Program sites were appropriate for protection of the environment and the most cost effective means to attain those goals.

2. **Are the remedies functioning as expected? How well are the remedies performing? Do you have any concerns regarding the function of the remedies?**

The Mather remedies are functioning as expected, mostly on expected schedule but some on a bit longer than expected timeline. The remedies selected are still appropriate and may need optimizations in the coming years, but that is not out of the ordinary.

3. **What do the groundwater and soil vapor monitoring data show? Are there any trends that show contaminant levels are decreasing?**

The monitoring data shows that contamination levels are decreasing generally but some groundwater areas show slight increases in contamination as plumes move.

4. **Have there been unexpected operation and maintenance (O&M) difficulties or costs at the former Mather AFB in the last five years? If so, please provide details.**

URS experienced one exceptional incident of theft and metal pilferage while unattended due to the remoteness that caused the shutdown of the AC&W GWTS. Repairs and security upgrades were implemented to prevent future occurrences.

5. **Has the former Mather AFB been in compliance with permitting and reporting requirements?**

Mather project has been in compliance with all permitting and CERCLA reporting requirements to my knowledge.

6. **Has the status of institutional controls been reported as required? What type of monitoring is currently being conducted or has been conducted to determine institutional control compliance? Have any deficiencies or violations of the institutional controls occurred?**

Institutional controls have been monitored and reported by the Air Force technical field team as required prior to the current PBR contract with URS. Although the responsibility was supposed to shift to the State, that has not yet occurred and it's not yet been determined by the Contracting Officer if URS should be responsible for this task until such transfer.

7. **Do you have any comments, suggestions, or recommendations regarding the implementation of the IRP remedies or how the program has been conducted in general?**

I have no comments, suggestions or recommendations regarding implementation of remedies.

8. **Do you have any comments or recommendations about the operation of the IRP remedies related to future effectiveness or optimization of operations?**

Regarding operations of IRP remedies, it must be made clear that optimization was meant to define the AF goals clarifying that it's the Air Forces interest for optimization to shorten cleanup times (total life cycle costs) and not the current contract costs of operations.

9. **What is your single greatest concern regarding the ongoing performance of the IRP remedies?**

Remedy lengths of time can be lengthened due to actions taken presently to reduce costs.

10. **Have any new or emerging contaminants been identified? If so, have they impacted the effectiveness of the remedies?**

The only new emerging contaminant identified recently is AFFF PFCs which haven't impacted the effectiveness of our remedies.

11. **Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.**

URS has implemented sampling strategies that have optimized efficiencies and saved on O&M costs; one example was by reducing the hard documents and monitoring sampling frequency of our landfills. This has saved unnecessary waste of time for URS in producing these reports and saved the time and efforts of AF and regulatory agencies in reviews.

Thank you for your feedback.

Former Mather AFB – Fourth Five-Year Review Interview Questionnaire

Please provide:
Name: Douglas V. Fortun
Title: Former Mather BEC (2009-2012)
Affiliation/Organization: None
Address and phone number: dvfortun@yahoo.com

1. **What is your overall impression of the remedies selected for the former Mather AFB's Installation Restoration Program (IRP) (e.g., excavation, SVE, groundwater extraction and treatment, landfill cap, and institutional controls)?**

   The remedies selected for the former Mather IRP matches were designed to further reduce and manage the remaining residual contamination at the site.

2. **Are the remedies functioning as expected? How well are the remedies performing? Do you have any concerns regarding the function of the remedies?**

   If nothing significant has changed to the site's environment, the remedies selected should be functioning smoothly, as expected.

3. **What do the groundwater and soil vapor monitoring data show? Are there any trends that show contaminant levels are decreasing?**

   Based on the GW and soil vapor monitoring data (2009-2012), the trend showed that the contamination levels was decreasing.

4. **Have there been unexpected operation and maintenance (O&M) difficulties or costs at the former Mather AFB in the last five years? If so, please provide details.**

   None observed.

5. **Has the former Mather AFB been in compliance with permitting and reporting requirements?**

   For period 2009-2012, there was one state non-compliance air permitting.

6. **Has the status of institutional controls been reported as required? What type of monitoring is currently being conducted or has been conducted to determine institutional control compliance? Have any deficiencies or violations of the institutional controls occurred?**

   For period 2009-2012, the status of the ICs has been routinely reported to state and federal regulators. No deficiencies or violations of ICs have occurred.

7. **Do you have any comments, suggestions, or recommendations regarding the implementation of the IRP remedies or how the program has been conducted in general?**

   None.

8. **Do you have any comments or recommendations about the operation of the IRP remedies related to future effectiveness or optimization of operations?**

   None.

9. **What is your single greatest concern regarding the ongoing performance of the IRP remedies?**

   None.

10. **Have any new or emerging contaminants been identified? If so, have they impacted the effectiveness of the remedies?**

    None.

11. **Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.**

    GW and SVE O&M and/or sampling efforts have been optimized in 2011-12.

Thank you for your feedback.

Former Mather AFB – Fourth Five-Year Review Interview Questionnaire

Provided by: **Date: 3/31/14**

Name William T. Hughes
Title Air Force Environmental Support Contractor
Affiliation/Organization Cherokee Nation Technology Solutions
Address and phone number c/o AFCEC, 3411 Olson Street, McClellan CA, 95652

1. **What is your overall impression of the remedies selected for the former Mather AFB's Installation Restoration Program (IRP) (e.g., excavation, SVE, groundwater extraction and treatment, landfill cap, and institutional controls)?**

The remedies have all seemed appropriate at the time; although some have been modified since to adjust to unexpected conditions (for example when excavation failed to remove enough contamination because of depth or nearby structures, soil vapor extraction was added to the remedy to address the contamination left after excavation) or to add land-use controls where some residual contamination will remain.

2. **Are the remedies functioning as expected? How well are the remedies performing? Do you have any concerns regarding the function of the remedies?**

Most of the remedies are functioning as expected, although soil vapor extraction has taken much more time than anticipated because it's harder to remove contaminants from finer-grained soils, particularly when they are wet.

Cleanup has progressed in the biggest groundwater plume to where most of the wells extracting from the B-zone gravels now have concentrations below cleanup levels; however, the remaining southwest lobe of the plume which has extend further southwest then monitoring results indicated when the extraction system was designed has fewer extraction wells than might be expected and should be evaluated to see if the extraction system would be more efficient if one or more new wells were added in conjunction with shutting off or reducing extraction on older wells that may no longer be needed to operate as they originally did.

We are still working to coordinate the practical aspects of some of the land-use restrictions to avoid unnecessarily delaying routine excavation to install or repair utilities within the roadway or public utility easement where these overlap with areas requiring notification response or approval from the Air Force and/or regulators.

3. **What do the groundwater and soil vapor monitoring data show? Are there any trends that show contaminant levels are decreasing?**

All of the groundwater and soil vapor monitoring networks show progressing cleanup in most wells, as indicated by stable or decreasing concentrations. However, there are still wells in which this progress is slow, or where concentrations are increasing despite the long-term extraction that has taken place. Sometimes this seems to make sense, such as in the Northeast Plume near landfill LF-04, where the water table has dropped about a foot a year and is now below the gravel layer in which groundwater would carry contaminants further from the source sort of like a conveyor belt moves luggage away from where it is unloaded. Now the plume is smaller, because the contamination seeping from the buried landfill waste isn't carried away very quickly, and it is also at higher concentrations, because there's less dilution as it enters the slower-moving water. In other places, we don't have any good explanation for increasing trends, and have to be patient and observe the patterns for several monitoring rounds to see if they persist and show any characteristic that helps us to understand and plan any improvements to our extraction system or monitoring well networks. This is the case with some wells at the Aircraft Control and Warning Site near the radar dome that looks like a giant golf ball.

4. **Have there been unexpected operation and maintenance (O&M) difficulties or costs at the former Mather AFB in the last five years? If so, please provide details.**

   There have been two noteworthy unexpected costs during this five-year review period. The first was the re-installation and operation of the carbon treatment system at an off-base well due to elevated concentrations that occurred in a few samples over a short period of time. Treatment could be curtailed again, as concentrations have been low enough for more than a year, but the costs of uninstalling and reinstalling are high compared to continuing to operate the system in the near term. The second instance was due to vandalism at the Aircraft Control and Warning Site groundwater treatment plant, where copper theft at the end of December 2012 resulted in about three months of system downtime and significant costs to restore the system to operating condition.

5. **Has the former Mather AFB been in compliance with permitting and reporting requirements?**

   I'll interpret this question to refer to the Air Force cleanup program rather than other parties who now own or lease land or facilities at Mather. The Air Force program has been generally in compliance with permitting and reporting requirements during the five-year review period. There have been a few inadvertent delays in reporting for the sewer permit, such as documenting flow-meter calibration late, or omitting the listing of heat exchanger water (clean water) on the monthly reports; both of these omissions were rectified once identified.

6. **Has the status of institutional controls been reported as required? What type of monitoring is currently being conducted or has been conducted to determine institutional control compliance? Have any deficiencies or violations of the institutional controls occurred?**

The initial requirement for annual reporting of institutional controls was in the 2006 Record of Decision for the Supplemental Basewide Operable Unit, and only applied to one site, the former skeet range Site 89. Additional reporting was required for other operable units in 2008 (Aircraft Control and Warning OU) and 2010 (Soil, Groundwater, and Basewide OUs). These requirements had not been included in any contract scope, so when we realized this during preparation of the last five-year review, we wrote the first annual compliance report in 2010 which reported on the compliance for all the ICs in place at that time. Subsequent annual reports have been prepared as required each year. Except for the vandalism at the AC&W Site, there have been no violations of ICs during the reporting period.

7. **Do you have any comments, suggestions, or recommendations regarding the implementation of the IRP remedies or how the program has been conducted in general?**

It's my job to provide comments, suggestions, and recommendations regarding the implementation of the IRP remedies, so, yes, I have lots of ideas. I try to make sure the program uses resources efficiently and effectively and that the work is well documented.

8. **Do you have any comments or recommendations about the operation of the IRP remedies related to future effectiveness or optimization of operations?**

I'm working with the Air Force on ideas for how to make sure optimization is defined in future contracts such that there's incentive for contractors to both reduce their own cost under performance-based, fixed-price contracts, but also pursue Air Force optimization goals to reduce the lifecycle costs or perhaps the duration required for ongoing cleanup.

9. **What is your single greatest concern regarding the ongoing performance of the IRP remedies?**

For the Mather program, my greatest concern is always staying informed and making proactive decisions in a timely manner about ways the remedies can be adjusted to perform better, and not managing in a reactive way. This is particularly important when monitoring data has unexpected results; for some locations where monitoring has become routine, it may be important to collect a confirmation sample to see if the unexpected results are valid rather than wait until the next scheduled sample that might be a year or two later.

10. **Have any new or emerging contaminants been identified? If so, have they impacted the effectiveness of the remedies?**

No new or "emerging" contaminants have been discovered at Mather sites.

11. **Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.**

In general, I'd say O&M and/or sampling efforts have been improved, enhanced, augmented, and made more efficient over the life of the program, but rarely have they been rigorously optimized in the mathematical sense of minimizing the time or cost of an effort, or maximizing the contaminant removal given the existing remedial system wells and treatment capacity. The one time we tried a rigorous, computer optimization effort for the AC&W groundwater system, the conditions had changed by the time the modeling was worked out and the recommended optimization methods were no longer applicable. Yet inspection of well sampling over time and adjustment of extraction pumping rates has led to pretty efficient operation of the groundwater extraction and treatment at that system.

Thank you for your feedback.

Former Mather AFB – Fourth Five-Year Review Interview Questionnaire

Provided by: **Date: 4/9/14**

Name: Paul Graff
Title: Mather Project Manager
Affiliation/Organization: URS Corporation
Address and phone number: 3411 Olson St, McClellan, CA 95652
916-643-1818

1. **What is your overall impression of the remedies selected for the former Mather AFB's Installation Restoration Program (IRP) (e.g., excavation, SVE, groundwater extraction and treatment, landfill cap, and institutional controls)?**
   I think these remedies are appropriate.

2. **Are the remedies functioning as expected? How well are the remedies performing? Do you have any concerns regarding the function of the remedies?** Yes, I think the remedies are mostly functioning well and as expected. There may be concerns about the time to reach cleanup goals.

3. **What do the groundwater and soil vapor monitoring data show? Are there any trends that show contaminant levels are decreasing?** Yes, most data indicate decreasing contaminant levels.

4. **Have there been unexpected operation and maintenance (O&M) difficulties or costs at the former Mather AFB in the last five years? If so, please provide details.** Yes, vandalism at the AC&W Groundwater Treatment Plant resulted in significant unanticipated repair and replacement costs.

5. **Has the former Mather AFB been in compliance with permitting and reporting requirements?** Yes.

6. **Has the status of institutional controls been reported as required? What type of monitoring is currently being conducted or has been conducted to determine institutional control compliance? Have any deficiencies or violations of the institutional controls occurred?** Yes. Ongoing and annual site inspections and Underground Service Alert excavation notifications are the primary institutional control

(IC) compliance monitoring mechanisms. I do not know of any IC violations or deficiencies, except possibly that the hand-over of IC monitoring and compliance reporting from the Air Force to the State of California needs to be ensured.

7. **Do you have any comments, suggestions, or recommendations regarding the implementation of the IRP remedies or how the program has been conducted in general?** I think the remedies are being appropriately implemented, although I believe the regulatory agencies are overly conservative in their assessment of remedial progress and the application of narrative cleanup levels.

8. **Do you have any comments or recommendations about the operation of the IRP remedies related to future effectiveness or optimization of operations?** No.

9. **What is your single greatest concern regarding the ongoing performance of the IRP remedies?** That site closures will be delayed by regulatory agencies overly conservative assessment of cleanup progress and remaining site risks.

10. **Have any new or emerging contaminants been identified? If so, have they impacted the effectiveness of the remedies?** No, not officially, although perfluorinated compounds are being investigated.

11. **Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.** Optimization is mostly occurring in the form of reduced sampling and reporting requirements, although these are not saving significant amounts of money.

Thank you for your feedback.

Former Mather AFB – Fourth Five-Year Review Interview Questionnaire

Provided by: **Date: 3/20/14**
Name: **George Bradshaw**
Title: **O&M Lead Operator**
Affiliation/Organization: **PBR Contractor/URS**
Address and phone number: **2870 Gateway Oaks, Sacramento, CA 95833, 916-826-1562**

1. **What is your overall impression of the remedies selected for the former Mather AFB's Installation Restoration Program (IRP) (e.g., excavation, SVE, groundwater extraction and treatment, landfill cap, and institutional controls)?**

   My overall impression is that the remedies are functioning well for the age of the equipment. Groundwater extraction and treatment technologies in use are dated and will soon require costly upgrades to keep the systems operating as expected.

2. **Are the remedies functioning as expected? How well are the remedies performing? Do you have any concerns regarding the function of the remedies?**

   There are a number of technologies in use which we have seen degrading over the last 4 years. We have also seen obsolescence in these technologies as direct replacement parts are either not available or very costly to repair/replace.

   Motor Operated Valves installed at extraction and injection well heads to regulate flow-rates are of poor design and costly to repair/replace. We have received permission to remove these as they fail and replace with manual flow control valves.

   The Fiber Optic Communications scheme that allows the SCADA/PLC to communicate with the well stations is obsolete and intermittent communication failures occur frequently. Optical Interface Cards are being replaced with units that are sent to a third party for repair. The daisy chained serial communications scheme in use should be updated as a failure at any location drops out all extraction wells downstream.

   Flow-meters located at all extraction and injection wells (date of manufacture 1998) are failing and sent back to the manufacturer for repair. New units are installed if unrepairable.

3. **What do the groundwater and soil vapor monitoring data show? Are there any trends that show contaminant levels are decreasing?**

4. **Have there been unexpected operation and maintenance (O&M) difficulties or costs at the former Mather AFB in the last five years? If so, please provide details.**

   See Number 2.

   An intrusion and copper theft event that occurred at the Mather AC&W location was a costly repair that forced an upgrade of the groundwater treatment system and base wide security enhancements. Upgrade to new computer system and new SCADA system was required due to the fact that the old SCADA software will not function on new computer operating systems. Security alarms systems and hardened accesses were installed as a result.

5. **Has the former Mather AFB been in compliance with permitting and reporting requirements?**

   All compliance samples are collected in accordance with their planned sampling frequencies and are reported monthly, quarterly, or annually as required.

6. **Has the status of institutional controls been reported as required? What type of monitoring is currently being conducted or has been conducted to determine institutional control compliance? Have any deficiencies or violations of the institutional controls occurred?**

   We monitor the institutional controls by performing an annual inspection of the sites. The inspections are recorded on a check list and then incorporated into a report. If any issues or deficiencies arise we collect a photo and remedy the issue. All the issues in the past 4 years have been minor (i.e. graffiti, unauthorized access).

7. **Do you have any comments, suggestions, or recommendations regarding the implementation of the IRP remedies or how the program has been conducted in general?**

8. **Do you have any comments or recommendations about the operation of the IRP remedies related to future effectiveness or optimization of operations?**

   See Number 2.

9. **What is your single greatest concern regarding the ongoing performance of the IRP remedies?**

My greatest concern is the eventual failure of Fiber Optics, PC controls and SCADA software resulting in the expense of new redesigned control and communication schemes. This is due to age and obsolescence of existing technologies.

10. **Have any new or emerging contaminants been identified? If so, have they impacted the effectiveness of the remedies?**

11. **Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.**

    Operations are running as efficiently as possible at this time.

Thank you for your feedback.

INTERVIEW RECORD

Site Name: Mather AFB	**Date:** 9 June 2014

Individual Interviewed:

Name: Don Nottoli	**Title:** County Supervisor	**Organization:** Sacramento County

Summary Of Conversation

Mr. Nottoli has been involved with Sacramento County for 36 years.

He said that there has been a lot of good work that's been done with the cleanup. He understands there is a long tail to finish the cleanup. The regulators, Air Force, State and community has worked together really well over the years. He complimented the agencies involved for the good work done. He appreciates the outreach that has been done, and that continues. The cleanup is proceeding in a good fashion, goals are being achieved; monitoring is in place to ensure certain thresholds are met. In general the cleanup is going along well, and is not hampering what is going on at Mather. He spoke of the redevelopment and employment opportunities Mather provides today, as well as the habitat preservation.

He said that for the most part, folks are not even knowledgeable about the cleanup because it is trusted that it's in good hands. People are confident in the Air Force and regulatory agencies. There was some issues and concerns with Happy Lane, but that has essentially been addressed. There are still pipelines and equipment (from the cleanup) still visible, but most people don't give it a second thought. The cleanup is pretty invisible, but it is very important work, that is very methodical and takes many years.

He is not aware of any current community concerns. There have been a couple of issues that have correlation to the cleanup, such as the Femoyer connection, some delays in the Zinfandel Road, but these issues were taken care of because the agencies work together to figure things out. There have also been some issues relating to public works projects, such as locating lines and pipes underground that weren't where people thought they were. There was also the fire at McCready (an excavator bucket sparked flames from the soil) that was noteworthy, but that type of thing is going to happen occasionally.

He feels very well informed. He said that there has been a few blips mentioned earlier, but nothing really regarding the toxics or cleanup. He said the Air Force has been a good strong partner, as have the regulators. He said that as time moves along there will be a whole new host of folks involved and new audiences so efforts to continue communication is important.

In regards to future communications, he asked if there is a web site to share information. He suggested working with established groups (City, County, Independence Housing) to share information. He said sharing status of cleanup is ok but it's more important to be able to communicate when needed. Maybe a meeting if something important comes up, but a bunch of meetings at this point is unnecessary. With 5,800 acres, there are a lot of different activities going on, but make sure the key people are involved – airport staff, parks, economic development, Bloodsource, Metro Fire, Heritage Credit Union, and the school districts. He said a challenge will be to maintain interest, and only when something goes sideways will those people then say "why didn't you keep us informed?". He said reaching out through email is ok, and offered to help evaluate current Air Force contact lists. He suggested possibly using Twitter if a big "hiccup" comes up, as well as other media and newspapers. He reiterated appreciation for the effort that goes into trying to communicate and make information available.

INTERVIEW RECORD

Site Name: Mather AFB		Date: 23 May 2014
Individual Interviewed:		
Name: Bob McGarvey	**Title:** Vice-Mayor	**Organization:** City of Rancho Cordova

Summary Of Conversation

Bob McGarvey was stationed at Mather in 1963 and has been a homeowner in Rancho Cordova since 1967. He is on the city council, a former mayor, was part of the RAB, a boardmember for the Mather Community Campus, and Rotary Club member, and a member of the Cordova Community Council.

The cleanup of Mather is one of the best efforts he has been around; it has been effective and has helped out the community because it has allowed Mather to flourish. He appreciated being part of the RAB because he remembers the background of the cleanup and the records of what's clean. He is aware that the groundwater still will take many years to clean up, but knows that it's being worked on and under control. He was able, through the RAB, to watch things and learn things that he otherwise probably would not have paid much attention to.

He said it is very helpful, now and over the years, to be able to either answer people's questions directly, or direct them to the Air Force to get more information. The cleanup is something the City is still interested in. The cleanup has had a positive impact on the community – Mather is very much a part of people's lives, through the history of the base and the current opportunity for jobs and recreation. There are now more than 5,000 people working here. People are happy it is cleaned up or being cleaned up, and now using it – instead of fencing it up or not actively using it.

He said that he is not aware of any current concerns about the cleanup. When the RAB first started, there was a lot of interest in the cleanup, both from the public and media. As time went on, he supposes that it became boring for most, and there was confidence the job would get done. Today, most people don't know it's there because the job is getting done and was done so well.

He is aware that there are institutional controls on the property that restrict land uses and where people may be able to dig or need to get clearance to dig. Some of that, as he understands is to prevent harm to current cleanup systems.

He likes being informed about what's going on – especially information such as when wells or sites are closed. He wants to know this information, but he believes other people don't care. He adds that there has been so much that has been done that people don't really need to know necessarily. He said it's good that people simply think of Mather as a place to go work.

For future communications, he said periodic updates to the City Council are the best way to inform the community. People may see that televised, and it gets into the record for people to view on the city web site. He suggests also sending information occasionally to the Grapevine and leave information at the City Hall. He says that people don't look at newspapers like they used to, more people prefer to go online. He suggested reaching out to the Rancho Cordova Elks Lodge and Sac Metro Fire.

He said that unless something important happens, people are going to just go on with their lives and are not that interested.

INTERVIEW RECORD

Site Name: Mather AFB		**Date:** 30 May 2014
Individual Interviewed:		
Name: Clark Whitten / Rick Balazs	**Title:** Deputy Director, Economic Development	**Organization:** Sacramento County

Summary Of Conversation

He has been employed by Sacramento County to redevelop Mather for the past 12 years.

He said the Air Force has done an excellent job pursuing environmental cleanup of the former base.

Aggressive cleanup by the Air Force has provided the County the ability to redevelop the former base to a point now where there are over 6,600 jobs and 60 businesses.

He is unaware of any community concerns regarding the site or cleanup.

He feels that is well informed about the site's cleanup and progress.

He prefers to be kept informed through email, and believe that email is the best way to communicate with the community about cleanup activities and progress.

He had no suggestions for groups or individuals to contact for additional input, nor did he have any other recommendations regarding communications.

He is aware of, and complying with ICs on portions of the former Mather AFB property. There are various plans to lease, sell, or transfer property where ICs are in place, and plans on building new structures on property where ICs are in place.

INTERVIEW RECORD

Site Name: Mather AFB	**Date:** 3 June 2014

Individual Interviewed:

Name: Phillip Benedetto	**Title:** Mather Airport Manager	**Organization:** Sacramento County

Summary Of Conversation

Mr. Benedetto has been with the airport for a year and a half. He lives in Carmichael.

He believes the Air Force has done a great job with the environmental cleanup program. He said the Air Force does a good job notifying them when they need airfield access and when there are any problems. He feels like the County and Air Force work well together.

He has not heard of any effects the cleanup program has had on the surrounding community, nor is he aware of any community concerns about the cleanup.

He said he feels well informed about the status of the cleanup program and of the progress that has been made.

He said that email is the best way for him to be reached and to stay informed.

He suggested that the Air Force consider possibly holding a public meeting once in a while, maybe every year or even every couple of years.

He did not have any other suggestions or recommendations about the cleanup or communications, nor did he know of any one else that should be contacted to provide input.

INTERVIEW RECORD

Site Name: Mather AFB	**Date:** 22 May 2014

Individual Interviewed:

Name: Sandra Lunceford	**Title:** Community Member	**Organization:** former RAB co-chair

Summary Of Conversation

Ms. Lunceford has been aware of and involved with the cleanup of Mather for nearly 20 years. She currently lives in Folsom, but was the RAB community co-chair for many years. Her general impression is that the cleanup has gone pretty well, and has a positive impact on the local community because it has helped support the redevelopment of Mather.

She is not aware of any current community concerns regarding cleanup at Mather. The only recent concern she is aware of is in regard to airfield noise. Initially when the base closed there were concerns about jobs. The media and some parts of the community were concerned about the cleanup in the past. The Grapevine Independent, in particular, was very involved and helped keep the Air Force accountable in the past. Over the years, the concerns about cleanup decreased and was then mostly only about jobs. As part of the RAB, she was directly involved with helping keep the community informed about cleanup – if people had questions they came to the RAB. Most people attended the RAB to learn.

She has not heard or seen any updates or information about the progress of cleanup since 2012. She says she has no knowledge now of what is going on at Mather. She has received at least one newsletter in the mail since 2012, but was disappointed in the content, feeling it was not very informative.

Her interest has mostly been about the containment of the groundwater plume.

She thinks newsletters with more in-depth information about cleanup should be distributed more frequently. She posed the question "How can you have Community Involvement when nothing goes out to the community?". She also questions the value of the current web site, and doesn't dig through the information on there unless she has to. She says people are generally unaware of the web site, and suggests adding a counter on the site to monitor site visits. She believes most people would rather receive something in the mail rather than go to a web site. She suggests assessing the efficiency of resources to communicate. She suggests putting together and distributing through the mail an annual summary. She also recommends using Facebook, and using various methods (McClellan RAB, Grapevine Independent, AF web site, City Hall, Bob McGarvey, Cordova City Council, Cordova Community Council, Chamber of Commerce, Neighborhood Association) to recruit Facebook followers.

She asked a few specific questions / requests for information:

- How does the drought affect cleanup?
- Is the plume contained, where is the leading edge of the plume?
- She saw construction cones on Bazley Way with some nasty-looking concrete, are they still taking samples under concrete as things are being ripped up? If they get hits, are people still being informed? Or do they just cover it up?
- She has seen some controversy regarding how the natural habitat will be preserved, such as the vernal pools out past the airfield, and would like to know what is happening with this, and is this controversy due to runway expansion?
- She would like to be assured concentrations are going down (in groundwater) and that the efforts and investment have had positive effect and/or showing a downward trend.
- She requested the Air Force reach out to development groups east of the base to make sure they are aware of the cleanup.

INTERVIEW RECORD

Site Name: Mather AFB		**Date:** 10 June 2014
Individual Interviewed:		
Name: Evan Jacob	**Title:** External Affairs Department	**Organization:** California American Water

Summary Of Conversation

He has been employed by California American Water for more than a decade.

He said that his understanding is that the cleanup has gone very well. The contaminants are being removed and the public is being protected while it's being done.

He said the customers he talks with express fear about contamination in the water. California American Water services the west side of the former base. He sometimes talks with people who are still concerned about what's in the water. He thinks that there is still a lot of concern there from the community members. The more outreach that can be done to explain to them that the water is being treated and that the water utilities are serving healthy water will make things better for all of us.

He thinks there is still a generalized concern among members of the community about the contaminants in the water. He feels it would be worth spending additional money on public outreach and education to talk about the successes that have occurred out there in the last decade.

He does not feel well informed about Mather specifically lately, largely because of changes within his organization, many people who worked on these issues ten of fifteen years ago for the most part on no longer with the company. So he no longer has the resources from them.

He would prefer to be informed in the future through email.

His company has never been huge on over-communicating with its customers. He feels the best way to communicate with the public is to get the information out there and available and try to educate key stakeholders about what the successes are and what the issues are that are remaining. Then hope the message filters down.

He feels that communicating with the Rosemont Neighborhood Association would be good. They are very active and have a lot of retired military people who worked at the base that are A - still drinking the water, and B - have a stake in it because they worked at Mather. Other neighborhoods have similar organizations and meetings as well as community newsletters that may be useful.

He did not have any other individuals he could recommend for us to speak with or other suggestions.

INTERVIEW RECORD

Site Name: Mather AFB		Date: 9 June 2014
Individual Interviewed:		
Name: Cheryl Hawkins	**Title:** Supervising Environmental Specialist	**Organization:** Sacramento County, Env. Management Division

Summary Of Conversation

Ms. Hawkins has been part of Sacramento County EMD since 2009.

She has a decent overall understanding of the environmental cleanup program at Mather, and sees the paperwork that comes through the office, but she isn't the person that handles all the details.

She has not heard of any effects the cleanup has had on the surrounding community, but would refer them to the Air Force. They have an existing referral process they would use.

She is not aware of any community concerns regarding the site or environmental cleanup and administration.

In the future, she believes that emails and public notification of any meetings would be best to help people decide if they would like to participate or not. She cited McClellan's web site as an example; it has good information about the ongoing cleanup. She believes that having information on a web site is much better than trying to track someone down to gain information.

She suggested that Sue Erickson from her office be contacted to also provide information or input, as she is the one that handles everything that comes through her office in regards to Mather.

She did not have any additional comments, suggestions or recommendations regarding communications about the cleanup.

INTERVIEW RECORD

Site Name: Mather AFB		**Date:** 12 June 2014
Individual Interviewed:		
Name: John Danciart	**Title:** Captain	**Organization:** Sacramento Metropolitan Fire District

Summary Of Conversation

He has been employed by the Sacramento Metropolitan Fire District for seven years, and currently works on Mather.

He doesn't really know anything about the cleanup at all, but assumed there was an environmental cleanup program in place because it was an Air Force base. He hasn't seen any effects in the surrounding community, nor is aware of any community concerns about the environmental cleanup.

Even though he does not feel informed about the cleanup, he said there really is no need for him to be informed because it does not impact his day-to-day operations. But if there is something necessary for him or his office to know then that's fine too, email is the best way to inform him.

Since he doesn't know what resources the community has or uses, he didn't have an opinion on the best way to connect with the community in general. He suggested going to the local home association meetings to figure out the best way to communicate with them and share information.

He did not have any other recommendations or suggestions.

INTERVIEW RECORD

Site Name: Mather AFB	**Date:** 3 June 2014

Individual Contacted:

Name: Lu-Anne Spencer-Hartle	**Title:** Elementary program coordinator	**Organization:** Splash

Summary Of Conversation

Ms. Spencer-Hartle joined Splash in 2001.

They are concerned about the pools that are going to be developed, where the boundary line is being drawn. She understands that it is a tradeoff and that some of the land will be protected and some will be developed, the part that is going to be developed has two vernal pools. One is home to an endangered species and the other is the only pool at Mather that the western spadefoot is found. Both of those pools are slated to be developed. Those two pools are pretty special. One of them is a pool they use to get samples for the kids to look at the little invertebrate in microscopes. The other houses the vernal pool tadpole shrimp, which is an endangered species. The other, as far as she knows, is the only pool the western spadefoot lives in out by the remote control airport. It's the only area at Mather where it hangs out.

She is not aware of any effects the cleanup program has had on the surrounding community, nor has she heard of any concerns from the community about the cleanup.

She said she does not really feel well-informed about the cleanup activities, but said she also doesn't actively seek out information.

She said email is the best way to reach her to provide information or updates about the cleanup, and believes that to be the case for most people as well.

She suggested reaching out to Meghan Amos, also with Splash, to seek her input. She had no other input, suggestions or recommendations about the cleanup or communications.

INTERVIEW RECORD

Site Name: Mather AFB		**Date:** 22 May 2014
Individual Interviewed:		
Name: Brenda Sylvia	**Title:** Mather Sports Complex Operations Supervisor	**Organization:** Rancho Cordova Parks and Recreation

Summary Of Conversation

Ms. Sylvia has worked at the Sports Complex for a year and a half.

She did not really have an opinion or impression on how the cleanup at the site has gone to date, mostly because she was not aware of the cleanup program.

She has not heard of any effects on the community from the cleanup program, nor has she heard of any concerns.

She said that she doesn't feel very well informed. She said she does see things going on at Mather but just drives on past it, so she's not really sure what it is.

She said that email would be the best method to communicate with her and believes that would be the case for most people.

She suggested reaching out to the following entities to provide input into the community relations efforts: VA Hospital, Mather Community Campus, and Volunteers of America. She had no other input or recommendations.

APPENDIX C

Regulatory Agency Comments and Responses to Comments

RESPONSES TO COMMENTS DRAFT FOURTH FIVE-YEAR REVIEW, MATHER AFB						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
1.				J.Lucey, EPA	**Executive Summary:** The Five-Year Review Report (Report) does not include an Executive Summary and it should. Most new five year reviews include an executive summary to provide a summary of the site's Operable Units (OUs) and the protectiveness statements for the OUs. Please include a table similar to Table 1-1, but organizing the new table so the sites are grouped together by OU.	The Five-Year Review Summary Form at the beginning of the document is intended to function as an Executive Summary. However, per EPA's request, an Executive Summary has been added to the draft final five-year review in general accordance with the template provided by EPA on 28 January 2015.
2.		SF-1, 1-3, and 6-3		J.Lucey, EPA	**Summary Form and Section 1.3 and 6.3:** The first page of the Summary Form has an item for "Review Period". The review period is the start time and end time for conducting the actual review and it should not indicate the entire five years period. Typically the review period would start on the date of the site inspection and end when the report is expected to be finalized. Sections 1.3 and 6.3 should describe the data set that was used for the five year review. Please include the cut off date that was considered in the Report. Generally this date corresponds with the date for the most recent Annual Basewide Monitoring Report.	Agree. The "Review Period" is shown as 27 March 2014 - 30 September 2015, which corresponds to the time period over which this five-year review report is being prepared. No changes are necessary. The last paragraph of Section 1.0 has been revised to state: "Data evaluated for this fourth five-year review cover the period from January 2009 through September 2014." In addition, the following text has been added to Section 1.3: "In general, data (continued)

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2. (cont'd)		SF-1, 1-3, and 6-3		J.Lucey, EPA		(continued) collected from 1 January 2009 through 30 September 2014 were reviewed for the technical assessment in this fourth five-year review, including those data presented and evaluated in the monthly, quarterly, semiannual, and/or annual progress monitoring reports, which are cited throughout this document, where appropriate. However, more recent data and analyses (through November 2014) are included for some sites. Section 6.3 includes more specific information on the documents and data reviewed for this fourth five-year review." Section 6.3 text has been similarly revised.

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
3.		SF-1		J.Lucey, EPA	**Review Status:** The Summary Form should include a date for the site inspection. The Site Inspection should also be described in Section 6.4 of the Report. A recent site inspection is required for the five year review as described below: *EPA or the lead agency conducts site inspections to gather information about a site's current status and to visually confirm and document the conditions of the remedy, the site, and the surrounding area. The inspection should be recent, and be conducted no more than nine months before the expected signature date of the review. At Federal facility sites, a State and/or EPA representative may wish to be present and/or participate in site inspections.*	The date the annual IC site inspections were conducted (10 March 2014) has been added to the Summary Form as the date of the site inspection for this five-year review, as the sites requiring IC inspection are included in this five-year review. In addition, the daily on-site presence of the O&M contractor, approximate weekly AFCEC personnel site visits, and periodic regulatory agency site visits ensure continuous monitoring of site status and remedy conditions.
4.		SF-2		J.Lucey, EPA	**OU 1 and 2, Issues and Recommendations:** The first 3 issues on the summary form are related to increasing concentrations of groundwater contamination and a potential lack of site characterization. Please revise the first three descriptions of groundwater issues so they all have consistent language. In addition, each of the three associated recommendations should include the possibility for additional site characterization and additional extraction wells for plume capture.	Based on discussions at the 27 January 2015 Technical Working Group meeting, and subsequent communication with EPA, the first two issues (TCE concentrations increasing in the AC&W Plume and potentially incomplete capture in the Southwest Lobe TCE plume) have been removed from the Draft Final Five Year Review. They are considered to be optimization issues and do not need to be included here. For additional information on those items, see response to CVWB comment number 7.

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
5.		SF-3		J.Lucey, EPA	**OU3, Recommendations**: The recommenda-tion for OU 3 should describe how the IC boundary will be expanded.	The text has been revised to read: "Further assess the extent of VOCs near Building 4260, and expand the IC boundary to the south and east via an appropriate decision document."
6.		SF-3 and 9-1		J.Lucey, EPA	**Protectiveness Statements and Sections 9.1 through 9.6:** Protectiveness statements are presented in the 5YR Summary Form and in Section 9 of the Report. Several of the OU Protectiveness Statements (AC&W, Groundwater and Basewide) use language such as "remedies are expected to be protective" which does not follow EPA guidance. Please replace this language with the following revised text: *"The remedy for the AC&W is short term protective for human health. For the remedy to be protective in the long term, the following actions need to be taken: …"*	The remedies at OUs 1 (AC&W), 2 (Groundwater), and 5 (Basewide) are protective. In accordance with the September 2012 EPA Memorandum *Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews*, the Protectiveness Statements have been revised as follows: "The remedy at OU 1 (AC&W OU) is protective of human health and the environment. "The remedies at OU 2 (Groundwater OU) are protective of human health and the environment in the short term. For the remedy to be protective in the long-term, the following actions need to be taken: the presence and magnitude of PFCs in groundwater must be determined; potential risks from exposure to PFCs must be evaluated; and appropriate remedies (if any) must be determined and documented in appropriate decision documents. (continued)

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6. (cont'd)		SF-3 and 9-1		J.Lucey, EPA		(continued) "The remedies at OU 5 (Basewide OU) are protective of human health and the environment." The Protectiveness Statements for the other OUs conform to EPA guidance. The above changes have also been made in Section 9.0.
7.		SF-4 and 9-1		J.Lucey, EPA	**Protectiveness Statements and Section 9.7:** It is appropriate for the Report to have one comprehensive protectiveness statement for the entire site because Mather AFB has achieved a Construction Complete. The comprehensive Protectiveness Statement should use the following language: *"The comprehensive remedy for Mather AFB is short term protective for human health. For the remedy to be protective in the long term, the following actions need to be taken: …"*	The comprehensive protectiveness statement in the Summary Form and Section 9.7 has been revised as follows: "The remedial actions at Mather AFB are short-term protective of human health and the environment. For the remedies to be protective in the long term, the IC boundary at Site SD-59 needs to be expanded to the south and east to address the potential risk to human health from the vapor intrusion pathway and additional investigation and risk assessment activities are needed at Building 4260 (which may be a new site)."

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
8.		SF-4		J.Lucey, EPA	**Protectiveness Statements:** The Report should be revised regarding MMRP Site GR405. MMRP Site GR405 is not an operable unit and it should be removed from the summary form. MMRP Site GR405 is not carried forward through the Report and it is hard to determine if it is protective or not, especially since it was not closed under CERCLA and there was no site inspection conducted. The body of the Report should describe MMRP Site GR405 and reference Appendix A. The Report should also clarify that the site was not closed under CERCLA and explain why the AF is including it in the Report.	References to the MMRP sites have been removed from the Draft Final. The paragraph following Table 1-2 in Section 1.3 discusses the inclusion of MMRP sites, some of which overlap with IRP sites in OUs 3, 5, and 6, in the five-year review and references Appendix A for the five-year review for MMRP sites, which was completed by a separate contractor. Additional text has been added to this paragraph to clarify DoD's position on the inclusion of MMRP sites in the five-year review. A site inspection was conducted at MMRP Site GR405 in March 2014 as part of the annual monitoring for IC compliance (AFCEC, 2014).
9.		9-1		J.Lucey, EPA	**Section 9.1 through 9.6:** Please add the OU number to the section title.	The OU numbers have been added to the section titles. For consistency, the OU numbers have also been added to section headings throughout the document.

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Comments						
1.	7.0			J.Brown, DTSC, GSU	**<u>Perfluorinated Compounds (PFCs) in Groundwater.</u>** PFCs have recently been detected in one of the groundwater treatment plants at Mather AFB but not published in any document to date. The details of the sampling effort, including which groundwater treatment plant the PFCs were detected at and the concentrations of the PFCs, should be discussed in the appropriate subsection of the technical assessment portion of the Report.	On 20 November 2014, the letter report *Perfluorinated Compound Detections from Groundwater Treatment Plants (GWTP) at the former Mather Air Force Base* (AMEC, 2014), was submitted to the regulatory agencies and included the work plan for collecting influent and effluent samples from the groundwater treatment plants for PFC analysis and also the results from the sampling effort. In Section 7.3.1.3 “Question C: Has any other information come to light that could call into question the protectiveness of the remedy?”, the following paragraph has been added: “Perfluorinated compounds (PFCs) are chemicals that have been classified as emerging environmental contaminants and are associated with the use of aqueous film forming foam during past fire training practices at Air Force Bases. In September 2014, influent and effluent samples were collected from the Main Base/SAC Area groundwater treatment plant and analyzed for PFCs. One compound, perfluorooctane sulfonate (PFOS), was detected in the influent (0.235 µg/L) and effluent (0.233 µg/L) samples at concentrations greater than EPA’s Provisional Health Advisory Level of 0.2 µg/L (AMEC, 2014). (Note that (continued)

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1. (cont'd)	7.0			J.Brown, DTSC, GSU		(continued) influent and effluent samples were also collected from the AC&W and Site 7 groundwater treatment plants; however, PFOS was not detected at a concentration greater than EPA's Provisional Health Advisory Level in those samples.) As of November 2014, AFCEC is preparing a strategy for follow-up sampling." A similar paragraph has been added to Section 7.3.2.3.
2.	7.4.3			J.Brown, DTSC, GSU	**Site 57** This section should be updated to include the recent soil vapor sampling data collected at the site. These data showed a higher than expected rebound for tetrachloroethene (PCE) and trichloroethene (TCE) and have significantly altered the analysis and conclusions currently presented in this section. Specifically, the elevated detections of PCE and TCE caused the withdrawal of the draft Site 57 closure report issued in April of 2014 and also triggered the restart of the soil vapor extraction (SVE) system.	The recent soil vapor data have not significantly altered the analysis and conclusions in this section in that the remedy for Site SD-57 is functioning as intended; the exposure assumptions, toxicity data, etc. are still valid; and there is no additional information that calls into question the protectiveness of the remedy. However, the text has been revised in Section 7.4.3 and other appropriate report sections stating that additional Site SD-57 soil vapor sampling prompted the postponement of the closure report and the resumption of SVE operations in September 2014.

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3.	7.4.4			J.Brown, DTSC, GSU	**Site 59.** This section should be updated to address following items:	
					a) Include a discussion describing the continued rebound of TCE observed in new vapor well 59-PW-07. TCE vapor in this well was detected at approximately one part per million (ppm) shortly after it was installed in January of 2014. The third sample collected in April of 2014 resulted in a detection of 2.3 ppm. And the in the latest sample collected in early October of 2014, TCE was detected at 4.9 ppm.	The referenced TCE rebound at 59-PW-07 is now discussed in Section 7.4.4.
					b) Include a discussion of the new wells the Air Force plans to install near Building 4260. These wells are being installed to help delineate the TCE contamination recently detected in well 59-PW-07 and to provide data to evaluate the potential for TCE vapor intrusion at Building 4260.	The new vapor wells are now discussed in Section 7.4.4 and other appropriate report sections.
		7-29	4th		c) Revise the 4th paragraph on page 7-29. These revisions are needed to clarify the following:	
					o That it is the Air Force's opinion only (not the regulatory agencies) that contamination at Site 59 is not high enough to justify continued SVE; and	This section has been extensively rewritten, precluding the suggested revision.
					o The new wells planned for installation and sampling near Building 4260 will provide the sampling data that will ultimately determine if continued SVE is warranted.	The new well data have been included and this section has been revised to recommend additional investigation and assessment activities.

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4.	8.2			J.Brown, DTSC, GSU	**Groundwater Operable Unit Issues.** This section should include a new issue addressing the recent detection of PFCs in a Mather AFB treatment plant. This section should discuss the workplan which is currently being prepared by the Air Force to investigate the scope of PFC contamination in groundwater. PFCs in groundwater should be recognized as an issue because 1) it is unclear how these compounds will be managed by regulators or the Air Force in the remedial program, and 2) their toxicity is still under evaluation and incomplete.	The following issues and recommendations have been added to Section 8.2. "**Main Base/SAC Area Plume Issue.** Influent and effluent samples collected in September 2014 from the Main Base/SAC Area groundwater treatment plant and analyzed for PFCs had detections of PFOS at concentrations slightly greater than EPA's Provisional Health Advisory Level of 0.2 µg/L. There are no promulgated cleanup standards for PFCs and no evidence that the remedy is not protective based on the PFC sampling results to date. "**Recommendation.** Conduct follow-up groundwater sampling for PFC analysis in the Main Base/SAC Area and Site 7 Plumes." **"Site 7 Plume Issue.** Influent and effluent samples collected in September 2014 from the Site 7 groundwater treatment plant and analyzed for PFCs indicated the presence of PFCs. There are no promulgated cleanup standards for PFCs and no evidence that the remedy is not protective based on the PFC sampling results to date. "**Recommendation.** Conduct follow-up groundwater sampling for PFC analysis in the Main Base/SAC Area and Site 7 plumes."

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5.	8.3			J.Brown, DTSC, GSU	**<u>Soil Operable Unit (OU) Issues.</u>** This section is incomplete because it addresses only Site 59 and only the expansion of its institutional control (IC) boundaries. The following issues need to be included in Section 8.3 to accurately reflect the status of the soil sites at Mather AFB. Each issue identified below needs to be acknowledged because each directly affects protectiveness evaluations and statements made later in the Report:	See responses below.
					a) <u>New Issue #1, Site 57: Unexpected Rebound and Threat to Groundwater.</u> Residual PCE and TCE contamination was recently detected in shallow and deep soil vapor wells at unexpectedly high concentrations (approximately 10 to 20 ppm, respectively) in well cluster 57-PW-07 and nearby monitoring wells. These detections occurred following a prolonged period of shutdown of the SVE system and during the absence of periodic monitoring. Concentrations of PCE and TCE in this well were anticipated by the Air Force to fail VLEACH modeling screening criteria set forth in the Record of Decision (ROD) (AFBCA, 1996), to predict groundwater impacts. As a result of the new data, the Air Force elected to restart the SVE system in late September of 2014.	This is not considered to be a new issue for the five-year review. The unexpectedly high soil gas concentrations did not indicate a new issue, but rather that the system needed to resume operation. New issues during the five-year review process are identified from the answers to the following site-specific questions from Section 7.0 - Technical Assessment (see Section7.4.3): Question A – Is the remedy functioning as intended by the decision documents? **For Site SD-57, the answer is yes.** Question B – Are the exposure assumptions, toxicity data, cleanup standards, and RAOs used at the time of the remedy selection still valid? **For Site SD-57, the answer is yes.**

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5. (cont'd)	8.3			J.Brown, DTSC, GSU		Question C – Has any other information come to light that could call into question the protectiveness of the remedy? **For Site SD-57, the answer is no.** No Site SD-57 issues are indicated based on the answers to the above questions. The unexpected rebound simply resulted in resumption of SVE operations for ongoing vadose zone soil remediation.
					b) New Issue #2.Site 57: Risk to Current Workers. The TCE rebound observed at well 57-PW-07 was also detected in shallow well 57-PW-06A located adjacent to currently occupied Building 7022. TCE concentrations in this well exceeded risk based screening levels (RSLs) indicating a potential threat exists to the worker(s) in this building from vapor intrusion pathways. The discovery of the TCE rebound in this well (in addition to well 57-PW-07) prompted the Air Force to restart the SVE system at the site and caused the Draft Site 57 Closure Report, recently submitted in April 2014, to be withdrawn.	This is not an issue. By resuming SVE operations and extracting from shallow SVE well 57-PW-06A, this potential risk is mitigated. Also, while the 57-PW-06A PCE concentration of 0.81 ppmv exceeds the RSL of 0.31 ppmv (calculated using guidance from DTSC's July 2014 HHRA Note No. 3), this would only represent a 2.6 x 10^{-6} risk (assuming the RSL represents a 1 x 10^{-6} risk), well within EPA's risk management range of 10^{-4} to 10^{-6}. Furthermore, this building is not regularly occupied, so there is no unacceptable risk to current workers. Risk will continue to be evaluated as the system is operated, when the system is shut down for rebound, and when SVE/vadose zone site closure is pursued.

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5. (cont'd)	8.3			J.Brown, DTSC, GSU	c) New Issue #3, Site 59: Plume Extent Undefined and Risk to Current Workers. TCE contamination in soil vapor was recently detected at concentrations higher than expected for this site (nearly 5 ppm as of October 2014) in shallow well 59-PW-07. This finding indicates a reasonable potential for the TCE plume at this site to extend beneath Building 4260 at concentrations which threaten workers in the building via the vapor intrusion pathway. The Report states that Building 4260, as a naturally ventilated hangar, supports a low potential for vapor intrusion and inhalation risk. However, data have not yet been collected by the Air Force at this time to either: 1) demonstrate workers in this building are currently protected or 2) show that the TCE vapor plume indicated by well 59-PW-07 is sufficiently small in extent and mass to support shutdown of the SVE system. d) New Issue #4, Institutional Controls (ICs) as Defined in the Explanation of Significant Differences (ESD) Document Do Not Protect Current Workers in Existing Buildings. Attempts to shut down the SVE systems at Sites 57 and 59 have not been supportable primarily because workers in existing buildings at these sites would be left unprotected from the vapor intrusion pathway. This has occurred because the ICs, as defined in the ESD (AFRPA, 2010), actually apply to only the future worker in newly constructed buildings. (continued)	This issue has been identified and discussed in the revised Section 8.3, along with recommendations for its resolution. See response below.

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5. (cont'd)	8.3			J.Brown, DTSC, GSU	Accordingly, once an SVE system is shutdown or closed, there is currently no obligation or requirement specified in the ESD for the Air Force to take any action to protect workers in existing buildings which overlie soil vapor plumes. Vapor intrusion protective measures are only required for future construction. Furthermore, the ESD does not require the Air Force or regulatory agencies to conduct any data analysis or risk evaluation at a site prior to allowing workers to enter an existing building which may present a vapor intrusion and inhalation risk from shallow plumes. If this check were in place, it is likely that Building 7022 at Site 57 would not be occupied by any worker(s) at this time. These oversights in the ICs introduce unnecessary and unacceptable risk to current and future workers in existing buildings at Mather AFB.	While not specified in the ESDs, the Air Force is evaluating risk to workers in existing buildings during SVE operations and during the SVE/vadose zone site closure process, as is evidenced by the responses to DTSC's Comments 5b and 5c above. In particular, the response to Comment 5b indicates no unacceptable indoor air risk in Building 7022 at Site SD-57. The Air Force does not agree that workers are or will be exposed to unacceptable risks, or that these oversights in the ICs introduce unnecessary and unacceptable risks to current or future workers.
					The limited scope of the ICs also causes unnecessary delays and disagreements during in the proposed shutdown of SVE systems. Therefore, the next version of this five-year review report should capture this topic as a new issue so it can be corrected in a timely fashion.	Where relevant, the issue of vapor intrusion risks at existing buildings is being addressed by current SVE operations and evaluations during site closure, as stated above.

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5. (cont'd)	8.3			J.Brown, DTSC, GSU	e) Revision to Site 59 IC Boundary Expansion Issue. This issue is appropriately described in Section 8.3 with the exception of the second to last sentence of the 1st paragraph. This sentence claims new data from recently installed wells at the site establish that "no significant TCE source remains." This sentence should be struck because new well installations and sampling of these wells are currently planned to answer the question of source. Conclusions cannot be drawn at this time regarding the TCE source until these additional data are collected and a compelling argument is constructed by the Air Force supporting the absence of a significant source.	This section has been extensively rewritten, including the suggested sentence deletion.
6.	9.3			J.Brown, DTSC, GSU	**Soil OU Protectiveness Statements.** a) Site 57: Section 9.3 needs to be revised to address the protectiveness to workers in Building 7022. Currently the operation of the SVE system may provide short term protection to these receptors. However, like Site 59, protectiveness to workers in this building cannot be provided until 1) data are collected inside the building or along its perimeter demonstrating the vapor intrusion pathway is incomplete or concentrations are below RSLs or other risk evaluation thresholds or 2) a vapor intrusion mitigation measure is implemented. ICs, as currently defined in the ESD, do not provide protection to workers in existing buildings.	The long-term protectiveness of the SVE remedy at Site SD-57 can be determined using data from the existing wells or by some other method (e.g., data collected from inside or other vapor intrusion method) at the time of SVE shutdown and vadose zone site closure, as discussed above. Therefore, the protectiveness statement does not need revision.

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6. (cont'd)	9.3			J.Brown, DTSC, GSU	b) Site 59: Section 9.3 states that workers in Site 59 will be protected in the long term from vapor intrusion once the expansion of the IC boundary occurs. However, this statement is not accurate because ICs, as defined in the ESD, do not require protective measures be implemented at existing buildings. At this time, only the operation of SVE system can provide some measure of protectiveness to these workers. Additional soil vapor data, collected adjacent to or underneath Building 4260, and/or indoor air sampling data are necessary to demonstrate protectiveness to these workers in the short term. Vapor intrusion mitigation systems or other mitigation measures implemented in the building are likely necessary to provide long term protectiveness to these workers.	The protectiveness statement has been revised to acknowledge the need for additional investigation and risk assessment activities at Building 4260 near Site SD-59, based on data from the new vapor wells 59-PW-09A and -09B. While the current ICs do not address indoor air risk at existing buildings, this risk will be evaluated as part of SVE termination and vadose zone site closure.

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GSU Comments #1, #3, #4, #5a, #5b, #5c, and #6				J.Brown, DTSC, GSU	In response to these GSU comments and others provided by the Regional Water Quality Control Board (RWQCB) and the United States Environmental Protection Agency (USEPA), significant revisions have been made in the draft Report to Sections 7.0 and 8.0 and 9.0. The changes made to these three sections adequately address GSU comments #1, #3, #4, #5a, #5b, #5c, and #6. With respect to comment #5, GSU concurs with the AF preference to not elevate the problem of Site 57 contaminant rebound to a new Five-Year issue on the basis that 1) continued operation of the SVE system is likely to provide protection to both human health and the environment, and 2) sampling of shallow vapor wells near Building 7022 will continue at an appropriate frequency providing the data necessary to evaluate risk to the worker in this building during SVE operation.	Comment noted. Comment noted.
GSU Comment #2				J.Brown, DTSC, GSU	The new paragraph added to Section 7.4.3 addresses GSU Comment #2. However, the new text conflicts with the last sentence of the second paragraph on page 7-28. Specifically, this sentence states impacts to groundwater are unlikely to occur but the new paragraph states the opposite condition. Please revise or delete this sentence.	The referenced sentence has been changed to the past tense because based on data in the draft five-year review, it was true (i.e., that groundwater impact was unlikely). The new paragraph mentions data collected later, in August 2014, which did indicate possible groundwater impact and prompted SVE restart.

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GSU Comments #5d. Vapor Intrusion Risk to Workers in Existing Buildings is Not Required in the ESD or Prioritized by the Air Force.				J.Brown, DTSC, GSU	The response to GSU comment #5d is not adequate. GSU comment #5d is resummarized below along with a recommended resolution. DTSC should not approve the Draft Final Five Year Report until this comment is resolved. *The Problem:* The explanation of significant difference (AFRPA, 2010) provides a closure process for soil sites which 1) fails to require the AF to evaluate vapor intrusion risk to current and future workers in existing buildings and 2) implements institutional controls (ICs) which do not protect workers in existing buildings. The soil site closure criteria defined in the ESD requires the AF to evaluate only the threat to groundwater and the ICs defined in the ESD require vapor intrusion protective measures for only the future worker in new buildings. *AF Response and GSU Comments:* The AF response to GSU comment #5d states that vapor intrusion risk is evaluated at soil vapor sites during closure evaluations suggesting this is a customary practice and implying no need to make this a formal issue in the Report. However, this response conflicts with how the AF has approached closure for Site 57 and Site 59 during the latest five year review cycle. For example, at Site 57, vapor intrusion risk was not evaluated in the draft closure report (continued)	The Air Force disagrees and believes the response to comment #5d is adequate. A vapor intrusion risk section has been added for each Mather SVE/BV site in the 2014 SVE/BV Annual Monitoring report, which includes assessing occupied or potentially occupiable buildings. This information will be included in subsequent monitoring reports and in site closure documents. As for the Site 57 example cited, there was no reason to believe that the available historical shallow well soil gas data were not adequate to assess the indoor air risk near occupied buildings, which was deemed insignificant based on that data. While the August 2014 shallow soil gas samples collected near buildings generally had higher VOC concentrations than previously, they were largely of the same order of magnitude as previous results and were not much greater than screening levels. For example, the highest of these was PCE at 810 ppbv and TCE at 650 ppbv at 57-SVE-06A, screened 14-32 feet bgs near Building 7022. While the results were higher than the previous (2009) sample results (PCE at 138 ppbv and TCE at 20 ppbv), the calculated indoor air screening levels (307 ppbv for PCE and 558 ppbv for TCE) were not greatly exceeded. In fact, if the screening levels represent a $1x10^{-6}$ lifetime excess cancer (continued)

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GSU Comments #5d. Vapor Intrusion Risk to Workers in Existing Buildings is Not Required in the ESD or Prioritized by the Air Force. (cont'd)				J.Brown, DTSC, GSU	(continued) submitted in April of 2014 using current soil vapor monitoring data. Instead, regulatory agencies had to request information on current building occupancy at the site (which was not described in the report). This request led to the discovery that Building 7022 was occupied causing DTSC to request recent shallow soil vapor monitoring data be collected at several wells (versus relying on five year old data from these wells) to evaluate risk to the occupant in Building 7022. Only after the results of these soil vapor data were obtained, and rebound was evident, was a risk assessment performed by the AF to evaluate protectiveness to current or future workers at the site. _Resolution:_ The Report should be revised to make this topic a new issue in Section 8.3 and document a commitment by the AF to evaluate vapor intrusion risk to workers in existing buildings as a primary closure criterion for soil sites (in addition to groundwater threat). The evaluation of vapor intrusion risk should be consistent with, or follow, the Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (DTSC, 2011) and address the following key topics: (continued)	(continued) risk, then the August 2014 data represent a risk of approximately $3x10^{-6}$, which is well within the 10^{-6} to 10^{-4} risk management range. The more significant higher concentration rebound at Site 57 noted in the August 2014 samples was in wells located in the presumed original VOC source area, which is not near any existing buildings. At this time, the closure process as it relates to vapor intrusion risk for soil vapor sites will not be identified as an issue in the five-year review. However, the AF is committed to evaluating vapor intrusion risks to workers at existing buildings in the annual SVE/BV monitoring reports (starting with the 2014 report issued in March 2015) and in site closure documents.

ADDITIONAL RESPONSES TO COMMENTS DRAFT FOURTH FIVE-YEAR REVIEW, MATHER AFB						
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GSU Comments #5d. Vapor Intrusion Risk to Workers in Existing Buildings is Not Required in the ESD or Prioritized by the Air Force. (cont'd)				J.Brown, DTSC, GSU	(continued) • Rebound period of the SVE system prior to collecting soil vapor monitoring data used to support closure, • The type of data which may be used to evaluate indoor air risk, including a sufficient number and depth of wells and the potential use of indoor air and sub-slab sampling data, and • The methods and modeling tool planned to calculate risk to indoor air receptors. ➢ Because of the importance of this issue, the process for evaluating and mitigating vapor intrusion risk to current and future workers should be documented via either a memorandum to the file or an addendum to the 2010 ESD. By taking these steps, the process for evaluating vapor intrusion will align with the process currently defined in the ESD for evaluating threats to groundwater from residual soil vapor contamination. This change affects Sites 57, 59, and Site 23C. Each of these sites has existing buildings which are currently, or could potentially be, occupied by workers which are at risk from vapor intrusion into indoor air from residual contamination at these sites.	

RESPONSES TO COMMENTS
DRAFT FOURTH FIVE-YEAR REVIEW, MATHER AFB

Comment Number	Section	Page	Paragraph	Reviewer	Comment	Response
General Comments – Human Health Risk Assessment						
1.				K.Gettmann, DTSC, HERO	IRP Site SD-57. The Report should be updated to reflect the current status of SD-57. According to Section 5.2.3 a draft closure report was issued documenting the recommendation for no further action is necessary for the vadose zone at SD-57. DTSC/HERO had concerns regarding the vapor intrusion to indoor air pathway for occupied buildings at SD-57 and rebound sampling at the site. Additional soil vapor samples were collected and soil vapor extraction (SVE) system was restarted.	The text has been revised in Section 7.4.3 and other appropriate report sections stating that additional soil vapor sampling results at Site SD-57 prompted the postponement of the closure report and resumption of SVE operations in September 2014.
2.				K.Gettmann, DTSC, HERO	Evaluation of the Aquifer Cleanup Level (ACL) Section 7.1.2 and Table 7-1. The ACLs for groundwater at the groundwater OUs are either the California or federal maximum contaminant level (MCL), if one exists for the COC. If a MCL does not exist than some other health-based guideline was used to establish an ACL such as a secondary MCL or EPA-suggested no-adverse-response level (SNARL). None of the ACLs established in the Record of Decision Reports have been revised and HERO concurs with the ACLs listed in Table 7-1. However, the ACLs were re-evaluated with the latest toxicity criteria data. The primary source for the toxicity data was the US EPA integrated Risk Information System (IRIS) database. Table 7-1 lists each COC, the ACL, current MCL, the US EPA tapwater regional screening level (RSL), the Office of Environmental (continued)	The 2004 EPA Region 9 preliminary remediation goal for PCE (0.10 µg/L) and associated ILCR (50 per million) have been added as a footnote to Table 7-1. The text following Table 7-1 starting with the fifth sentence has been changed. : "The cumulative risk estimate for this five-year review is approximately 64 in 1 million, which is within the risk management range. The cumulative risk using the PHG risk assumptions is 120 in 1 million, of which PCE contributes approximately 69 percent. However, it is not known that the risks are actually cumulative, and this assessment presents the worst-case scenario by assuming that the risk from all the contaminants is additive. This evaluation also assumes that concentrations in a hypothetical water (continued)

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Comment Number	Section	Page	Paragraph	Reviewer	Comment	Response
2. (cont'd)				K.Gettmann, DTSC, HERO	(continued) Health Hazard Assessment (OEHHA) public health goal (PHG), and the incremental lifetime cancer risk (ILCR) estimated for each ACL using both the RSL and PHG risk assumptions. Please note, HERO recommends using the US EPA tapwater RSLs in-conjunction with the Cal-Modified RSLs as discussed in our HHRA Note 3 (http://www.dtsc.ca.gov/AssessingRisk/upload/HHRA-Note-3-2.pdf). The only COC listed in Table 7-1 with a Cal-Modified RSL is PCE. For completeness, please include the PCE Cal-Modified RSL of 0.10 µg/L in Table 7-1, and associated ILCR.	(continued) sample consist of all of the COCs at ACL concentrations and that this is the sole drinking water source for the assumed exposure. This assumption is overly conservative, as some of the COCs are rarely detected in groundwater at Mather and not all of the COCs listed in Table 7-1 are COCs for each of the four ground-water plumes. For example, in the Site 7 plume, vinyl chloride was detected in only one well in 2013. If vinyl chloride is included in the cumulative risk estimate, the sum of the risk estimates is 51 in 1 million and 105 in 1 million, using the RSL and PHG risk assumptions, respectively. However, if vinyl chloride is excluded from the cumulative risk estimate, the sum of the risk estimates is 25 in 1 million and 95 in 1 million, using the RSL and PHG risk assumptions, respectively. These estimates are within the risk management range. For the other three plumes (AC&W, MBS/SAC Area, and Northeast), the cumulative risk estimates for the COCs for those plumes are all less than 100 in 1 million regardless of whether the RSL or PHG risk assumptions are used. See Table 3-1 for a list of COCs by plume. (continued)

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
2. cont'd)				K.Gettmann, DTSC, HERO		(continued) "The DTSC recommends use of the 2004 EPA Region 9 PRG of 0.10 µg/L for PCE as the RSL (DTSC Office of Human and Ecological Risk, 2014). This PRG is based upon the California OEHHA 1991 toxicity value for TCE, and is approximately 23 times more stringent than the updated EPA IRIS (2012) value. Using the EPA hierarchy, the DOD and Air Force use the updated IRIS (2012) value. For completeness, comparisons to the DTSC recommended value are included here. Using 0.10 µg/L for PCE would increase the cumulative risk estimate for this five-year review to 114 in 1 million. For the Site 7 Plume example, using the DTSC-recommended RSL for PCE would increase the cumulative risk to 101 in 1 million if vinyl chloride were included, and to 75 in 1 million if vinyl chloride were excluded. For the other three plumes, the cumulative risk estimate would still be less than 100 in 1 million if the DTSC-recommended RSL were used."

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
3.				K.Gettmann, DTSC, HERO	Lead (Sections 7.1.2, 7.1.3, 7.6.1.1). The cleanup levels for lead in soil at Sites FT-10C/ST-68, OT-87, and OT-89 established in the ROD are 800 mg/kg (15 mg/L soluble), 700 mg/kg, and 192 mg/kg, respectively. In the ROD, these lead soil concentrations were considered health-protective under commercial, industrial, or recreational land use scenario but not under unrestricted land use. Institutional Controls (ICs) are in place for Sites OT-87 and OT-89 to prevent unrestricted land use. Following excavation of soil at Site FT-10C/ST-68, the lead concentrations remaining were less than 151 mg/kg. The Report states (page 7-5): *"Therefore, ICs related to lead contamination are not required at Site FT-10C/ST-68. In additon, it should be noted that 151 mg/kg is less than EPA's 400 mg/kg residential RSL for lead.* *In 2009, OEHHA developed revised industrial and residential California human health screening levels (CHHSLs) for lead. The residential CHHSL for lead in soil is 80 mg/kg, and the industrial CHHSL for lead in soil is 320 mg/kg (OEHHA, 2009). The residential CHHSL is less than the 151 mg/kg threshold of concern compatible with unrestricted use established in the Basewide ESD* (continued)	As stated in the report and quoted above by the reviewer, the Air Force does not consider CHHSLs to be ARARs. The 151 mg/kg unrestricted use level established in the ESD is considered health protective, and ICs are not needed at Site FT 10C/ ST 68. The text of the first paragraph of Section 7.1.2 that discusses the lead results has been changed: "Following excavation, the maximum lead concentration remaining in soil following excavation at Site FT-10C/ ST-68 was 127 mg/kg with an average concentration of 44 mg/kg and median concentration of 19 mg/kg. These concentrations are less than 151 mg/kg, and all soluble lead concentrations were less than 15 mg/L (MWH, 2009b)." A new final paragraph in Section 7.1.2 has been added: "For completeness, a 95th upper confidence limit (95th UCL) of the mean was calculated for lead concentrations remaining at the three sites. For Site FT-10C/ST-68, results indicate that the 95th UCL is 101.4 mg/kg. Inputting this result into the updated DTSC LEADSPREAD model yields a 90th percentile estimate of increase in blood lead level in a child of 1.3 µg/dl. For (continued.)

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
3. (cont'd)				K.Gettmann, DTSC, HERO	(continued) [explanation of significant difference] *for Site FT-10C/ST-68; however, it is the Air Force's position that CHHSLs are not promulgated standards, are not enforceable, and are not ARARs* [applicable or relevant and appropriate requirement] *for Site FT-10C/ST-68. The 151 mg/kg unrestricted use level established in the ESD is health protective, and ICs are not needed at Site FT-10C/ST-68. Consequently, no new standards have been promulgated or proposed since remedy selection that would call into question the protectiveness of the remedy for soil at Site FT-10C/ST-68.*" The lead concentrations remaining in soil at Site FT-10C/ST-68 were not re-evaluated using OEHHA's toxicity evaluation of lead, replacing the 10 µg/dL threshold blood concentration with a source-specific "benchmark change" of 1 µg/dL. HERO does not agree with this. Several other federal facilities sites and non-federal facilities sites (continued)	(continued) OT-87, the 95th UCL from the area covered by the ICs is 254.4 mg/kg, and the 90th percentile increase in blood lead level for a child is 3.3 µg/dl. For OT-87 outside the area covered by the ICs, the 95th UCL concentration is 41.1 mg/kg, and the 90th percentile estimate of increase in blood lead level in a child is 0.5 µg/dl. For OT-89, inside the IC area, there were too few sample point from which to calculate a 95th UCL, but over most of this area the lead-bearing horizon is buried and not readily available for exposure. The maximum concentration detected in samples from this area is 16.3 mg/kg. For the areas outside the IC area, to the north, the 95th UCL is 57.27 mg/kg, and the 90th percentile estimate of increase in blood lead level in a child is 0.7 µg/dl; to the south, the 95th UCL is 75.4 mg/kg and the child blood lead level is 0.9 µg/dl." (continued on page 6, below)

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
3. (cont'd)				K.Gettmann, DTSC, HERO	(continued) use the source-specific "benchmark change" of 1 µg/dL as remediation goals. Please note, regarding evaluating cleanup HERO recommends calculating an Upper Confidence Limit (UCL) for the 95th percentile value of the mean lead concentration for each exposure area. If individual samples exceed the CHHSL, it would not mean that the exposure area itself is in exceedance of the CHHSL as long as the 95th UCL itself is below the CHHSL 80 mg/kg (residential) or 320 mg/kg (industrial), assuming hot spots are not present. HERO recently revised the LeadSpread 8 Model to account for the source-specific "benchmark change" of 1 µg/dL. The Model can be used to establish whether the remaining concentrations of lead in soil results in a 90th percentile estimate of blood lead equal to or less than 1 µg/dL. For additional information please see HHRA Note 3: http://www.dtsc.ca.gov/AssessingRisk/upload/HHRA-Note-3-2.pdf. LeadSpread 8 Model can be found at: http://www.dtsc.ca.gov/AssessingRisk/LeadSpread8.cfm. (continued)	

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
3. (cont'd)				K.Gettmann, DTSC, HERO	(continued) The cleanup level for Sites OT-87 is 700 mg/kg and for OT-89 is 192 mg/kg. Please note that the cleanup level of 192 mg/kg is health-protective under the commercial/ industrial scenario; however, the cleanup goal of 700 mg/kg is not health-protective under the commercial/industrial scenario based on OEHHA's source-specific "benchmark change" of 1 µg/dL. The ICs in place at Sites OT-87 and OT-89 is to prevent unrestricted land use. For lead remaining in soil at Site OT-87, the toxicity data used at the time of the remedy are no longer valid and the remedy is thus no longer health-protective for the industrial/commercial worker (Section 7.1.3 of the Report).	In addition to the IC that prohibits residential-type development at Site OT-87, an additional IC is in place to prohibit disturbance of soil within the IC area (see Figure 4-16) that may contain elevated lead concentrations until and unless it is demonstrated that lead concentrations in the soil at the site are no longer a threat to human health and the environment, and without first obtaining written approval from the ROD signatories, including the Air Force, U.S. EPA, and the State of California. Therefore, this restriction is protective of anyone for any type of land use, including the industrial/commercial worker.

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Comment Number	Section	Page	Paragraph	Reviewer	Comment	Response
4.				K.Gettmann, DTSC, HERO	Vapor Intrusion to Indoor Air for Existing Buildings. The text on page 7-1 states, "ICs to prevent potential unacceptable exposure to VOCs in indoor air have been added to the remedies for Sites FT-10C/ST-68 and LF-18, and as necessary for Sites ST-37/ST-39/SS-54, SD-57, OT-23C, and SD-59. The authorizing ESDs state that these ICs will be imposed only if necessary (AFRPA, 2010a; 2010b). If the site soil vapor data demonstrate that all of the soil vapor concentrations at a given site are compatible with unrestricted land use, these ICs will no longer be required by the remedy. Sites FT-10C/ST-68 and LF-18 were closed with indoor air ICs deemed necessary." Please address whether or not there is any potential risk from vapor intrusion to indoor air for all existing buildings in each OU. Please note that US EPA Region 9, DTSC, and US EPA Headquarters recently released guidance memoranda on how to address short term exposure to TCE. These guidance memoranda can be located at: US EPA Region 9 - http://www.epa.gov/region9/superfund/prg/files/r9-tce-interim-action-levels-response-recs-memo-2014.pdf; DTSC - https://dtsc.ca.gov/AssessingRisk/upload/HHRA_Note5-pdf-pdf.pdf; and US EPA Headquarters – http://www.epa.gov/superfund/sites/npl/TCE_compilation_final.pdf and http://www.epa.gov/superfund/sites/npl/hrsaddition.htm.	Existing buildings at each SVE site are being assessed for potential indoor air risks due to subsurface VOC vapor intrusion during SVE operations and the SVE/vadose zone site closure process. In particular, Building 4260 at Site SD-59 is discussed extensively in the revised report. Resumption of SVE operations at Site SD-57 addresses this issue at that site. None of the other sites have existing buildings that are deemed to be at risk.

RESPONSES TO COMMENTS DRAFT FOURTH FIVE-YEAR REVIEW, MATHER AFB						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
5.				K.Gettmann, DTSC, HERO	Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are chemicals on the emerging contaminant list since they are environmentally persistent and could bioaccumulate in the food chain. The use of aqueous film forming foam (AFFF) during fire training and for firefighting at Air Force Bases could result in the release of PFOS and PFOA in soil, sediment and groundwater. There are two fire training areas identified in the Report, FT-10C and FT-11. For FT-11, a work plan to sample the sediment, soil and groundwater for PFOS and PFOA is currently under review. However, please address where areas that storaged the AFFF and FT-10C have been or will be sampled for PFOS and PFOA.	Site FT-10C was not in use during the time AFFF was used (starting in 1970) and will not be sampled for PFCs. Fire training exercises were conducted at Site FT-10C from approximately 1947 to 1958. Fire training was relocated from FT-10C to Site FT-11 when the fuel storage system at Site ST-68 was built. The Air Force is preparing a preliminary assessment to identify other areas where AFFF may have been stored.

<table>
<tr><th colspan="7">RESPONSES TO COMMENTS
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<tr><th>Comment Number</th><th>Section</th><th>Page</th><th>Paragraph</th><th>Reviewer</th><th>Comment</th><th>Response</th></tr>
<tr><td colspan="7">General Comments – Human Health Risk Assessment</td></tr>
<tr><td>1.</td><td></td><td></td><td></td><td>K.Gettmann, DTSC, HERO</td><td>HERO concurs with and appreciates the Air Force's responses to our General Comments 1, 2, and 5. HERO reviewed the Draft Final Report and the text was revised as recommended in the responses. No additional response is necessary.</td><td>Comment noted.</td></tr>
<tr><td>2.</td><td></td><td></td><td></td><td>K.Gettmann, DTSC, HERO</td><td><u>Response to General Comment 3 – Lead.</u> DTSC/HERO met with the Air Force on January 27, 2015. During our meeting we discussed the Air Force's response to the comment and HERO's recommendations. HERO recommended that for transparency, completeness and as an additional line of evidence for the risk managers, to use the OEHHA specific "benchmark change" of 1 µg/dL to calculate the Upper Confidence Limit (UCL) for the 95th percentile value of the mean lead concentration under the following scenarios: 1) the residential scenario for Site FT-10C/ST-68; 2) the industrial scenario for Sites OT-87 and OT-89; and 3) the residential scenario for the perimeter of Site OT-89 as discussed during the meeting. Please note that if individual samples exceed the CHHSL, it would not mean that the exposure area itself is in exceedance of the CHHSL as long as the 95th UCL itself is below the 80 mg/kg (residential) or 320 mg/kg (industrial), assuming hot spots are not present. The Air Force agreed to perform these calculations and present the information. HERO looks forward to this information.</td><td>For completeness, the Air Force has calculated the 95th UCL of the mean lead concentrations for the scenarios and the LEADSPREAD 8 results requested by DTSC. Text in Sections 7.1.2, 7.6.1.2, 7.6.4.2 and 7.7.1.2 has been changed. Results are as follows:
<table>
<tr><th>Site</th><th>Residual lead 95th UCL of mean (mg/kg)</th><th>Comparison CHHSL (mg/kg)</th></tr>
<tr><td>FT-10C/ ST-68</td><td>101.4</td><td>Residential: 80</td></tr>
<tr><td>OT-87 in IC area</td><td>254.4</td><td>Industrial: 320</td></tr>
<tr><td>OT-87 outside of IC</td><td>41.0</td><td>Residential: 80</td></tr>
<tr><td>OT-89 in IC area</td><td>Could not be determined</td><td>Industrial: 320</td></tr>
<tr><td>OU-89 Outside of IC</td><td>75.08</td><td>Residential: 80</td></tr>
</table>
We note that the new OEHHA CHHSLs not ARARs. To date EPA has not changed its guidance of 400 mg/kg residential and 800 mg/kg industrial.
(continued)</td></tr>
</table>

RESPONSES TO COMMENTS DRAFT FOURTH FIVE-YEAR REVIEW, MATHER AFB						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
2. (cont'd)				K.Gettmann, DTSC, HERO		(continued) The 95 UCL values are less than the ROD and/or ESD cleanup levels of 151 mg/kg (15 mg/L soluble) (Site FT-10C/ST-68), 700 mg/kg (OT-87), and 198 mg/kg (OT-89. When combined with the ICs for Site OT-87 and OT-89, the remedies are protective.
3.				K.Gettmann, DTSC, HERO	<u>Response to General Comment 4 – Vapor Intrusion to Indoor Air for Existing Buildings.</u> The Air Force response to our comment stated that "existing buildings at each SVE site are being assessed for potential indoor air risks due to subsurface VOC vapor intrusion during SVE operations and the SVE/vadose zone site closure process. In particular, Building 4260 at Site SD-59 is discussed extensively in the revised report. Resumption of soil vapor extraction (SVE) operations at Site SD-57 addresses this issue at the site. None of the other sites have existing buildings that are deemed to be at risk." HERO appreciates the Air Force's Response; however, we have the following additional comments regarding the response and revised text in the Draft Final Report.	(See response below.)

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
3. (cont'd)				K.Gettmann, DTSC, HERO	a. *Site SD-57*. The revised text on page 7-28 (Section 7.4.3.1) states that the SVE system was restarted due to "unexpectedly high TCE rebound and residual soil vapor concentrations that may impact groundwater." The revised text did not address whether these unexpectedly high TCE concentrations could impact indoor air and risk to occupants of buildings at Site SD-57. Please address this issue. Additionally, please address whether there would be risk to occupants via the indoor air path if/when the SVE system is not operating.	The text has been revised to discuss indoor air risk with the SVE system not operating and operating, based on the most recent soil gas data.
					b. *Site SD-59.* i. To address uncertainty in shallow TCE soil vapor concentrations, nested vapor wells 59-PW-09A and 59-PW-09B were installed and sampled in November 2014. These wells were installed in front of Building 4260. The detected concentrations of TCE were 5.7 ppmv at 59-PW-09A and 7 ppmv at 59-PW-09B. The new text discusses the estimated cancer risk from these samples to occupants of Building 4260; however, there is no discussion of the potential noncancer hazard associated with these detections. Of particular concern is the potential short term noncancer hazard to sensitive populations. HERO calculated the noncancer hazard for 59-PW-09A to be 3.5 and 4.3 for 59-PW-09B, both greater than the target hazard of 1. Please include the noncancer hazard associated with the detected TCE concentrations in the newly added text.	Based on AECOM'c calculations, TCE concentrations of 5.7 ppmv and 7 ppmv represent noncancer hazard indices of 3.8 and 4.7, based on 1.5 ppmv TCE corresponding to a noncancer hazard index of 1.0. These values are slightly greater than those noted in HERO's comment, but they have now been included in the Site 59 Section 7.4.4.1 text.

RESPONSES TO COMMENTS DRAFT FOURTH FIVE-YEAR REVIEW, MATHER AFB						
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3. (cont'd)				K.Gettmann, DTSC, HERO	ii. New text added to Sections 7.4.4.1 and 8.3 states, "Building 4260 is a large, open, hangar-type structure that is unlikely to have significant vapor intrusion issues, certainly not in the short-term." HERO recommends this statement be revised from the Report for several reasons. There are offices located on the south wall where new wells 59-PW09A and 09B were installed and the current soil vapor data indicate a potential cancer risk of 1.25E-5 and noncancer hazard 4.3 for 59-PW-09B. While there may not be a significant cancer risk or noncancer hazard to the main bay of the building, we do not know if there is a cancer risk to the offices. Additionally, at this time the source of the TCE detections is unknown, and we do not know if preferential pathways exist in the offices. Finally, we do not know if the TCE concentrations in the soil vapor could be higher than detected.	The text has been revised, as requested.
					iii. HERO recommends collecting indoor air samples in the offices sooner rather than later to ensure there is no current risk to occupants given the soil vapor results.	The Air Force will consider this action.

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3. (cont'd)				K.Gettmann, DTSC, HERO	iv. HERO does not concur with the new text added to Section 7.4.4.3 that states, "no other information has come to light that could call into question the protectiveness of the remedy at Site SD-59 as originally defined." The recent soil vapor data at the south wall of the Building 4260 calls into question whether the current remedy is protective. Please revise the text in Section 7.4.4.3. v. At several locations in the Draft Final Report the term "well within the EPA acceptable risk management range" appears (Section 7.4.4.1 and Section 8.3). HERO disagrees with the use of "risk acceptable range" and requests that this terminology be removed from the Report. The actual level of acceptable risk is a site-specific risk management decision, with 1×10^{-6} as the point of departure for making such decisions. Clear justification must be provided for risk management decisions which result in residual risk levels greater than 1×10^{-6}.	Because these new wells appear to indicate a different source, the original Site 59 remedy is considered protective. There is no remedy for this new source area, which requires additional investigation activities, as recommended in the five-year review. The text has not been changed. Where "acceptable" occurs in the text of the five-year review in front of "risk management range", the word "acceptable" has been deleted.

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
4.				K.Gettmann, DTSC, HERO	Section 9.7 – Comprehensive Protectiveness Statement for Mather. New text states, "For the remedies to be protective in the long term, the IC boundary at Site SD-59 needs to be expanded to the south and east to address the potential risk to human health from the vapor intrusion pathway and additional investigation and risk assessment activities are needed at Building 4260 (which may be a new site)." HERO concurs that an additional investigation and a risk assessment is needed at Building 4260, however, the text is very vague and does not specify the type of investigation. Please include definite language in the Report as to what type of investigation is needed.	The Air Force is still considering what specific investigation and assessment activities are needed. Therefore, the text has not been changed.
					CONCLUSIONS HERO reviewed the Responses to our October 22, 2014 memorandum and the Draft Final Fourth Five-Year Report, Former Mather Air Force Base, Former Mather Air Force Base, Sacramento, as it relates to human health risk assessment. HERO concurs with the Air Force's Responses to our General Comments 1, 2 and 5. HERO has additional comments regarding our General Comments 3 and 4 and several new comments regarding the revised text added to the Draft Final Report. HERO recommends that all of the issues discussed be addressed prior to acceptance and finalization of this Report.	 Comment noted. See responses to comments above.

RESPONSES TO COMMENTS DRAFT FOURTH FIVE-YEAR REVIEW, MATHER AFB						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
General Comments						
1.				M.Pierce, CVWB	For each site that is evaluated in the Draft Report, transfer of these sites is briefly discussed. The Draft Report does not identify the parcels involved in transfer of each site, which makes the discussion rather confusing. For example, Section 7.5.1.1 states ".. the two parcels associated with LF-03 were transferred from Air Force ownership…" and later states "a SLUC is in place for the parcel containing Site LF-03 and another SLUC is in preparation for the parcel containing part of the 1,000-foot buffer around LF-03. From this description it is impossible to determine which parcel contains LF-03 and is already subject to a SLUC. To facilitate discussion of site transfers and land use covenants, the Air Force needs to add a new figure to the Draft Report that clearly identifies the sites and parcels at the former Mather AFB. Furthermore, the text in the Draft Report should be revised to identify the specific parcels involved in each site transfer and refer to the new figure.	Figure 2-1 now shows the parcels, in addition to the sites, and is referenced in the text. Specific parcels are also referenced in the text.

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Comment Number	Section	Page	Paragraph	Reviewer	Comment	Response
2.				M.Pierce, CVWB	Potential vapor intrusion into existing buildings from open soil vapor extraction (SVE) and/or bioventing sites has become an increasing concern. The remaining open sites will involve leaving residual soil contamination containing volatile contaminants such as tetrachloroethene, trichloroethene, carbon tetrachloride, benzene, naphthalene, and/or total petroleum hydrocarbons as gasoline. Currently, the Record of Decision does not provide for protection from vapor intrusion into existing buildings. The Air Force needs to determine if any existing buildings at sites 37/39/54, 57, 59, 23C, and 29/71 are at risk from vapor intrusion from residual volatile contamination. Given this overlooked potential exposure pathway, the Air Force may also need to modify their conclusions on the protectiveness of each site remedy in the Draft Report.	Based upon calculated shallow soil gas screening levels (using guidance from DTSC's July 2014 HHRA Note No. 3), none of the sites contain VOCs with a greater than 10^{-4} excess cancer risk. Also, there are few existing, occupied buildings at these sites. Based on the SWRCB low-risk closure criteria, there is no excessive (i.e., >10^{-6}) vapor intrusion risk at Site 37/39/54. This is also the case at Site 29/71, but this is a non-CERCLA site not included in the five-year review report. There is no excessive vapor intrusion risk at Site 23C based upon shallow vapor well data near the existing buildings. Site 57 may have shallow soil gas VOCs with a greater than 10^{-6} risk (although not greater than 10^{-4}) near an existing, possibly occupied, building, based on data from vapor well 57-SVE-06A, but active SVE is currently taking place at this well, which mitigates that risk. Site 59 may have shallow soil gas VOCs with a greater than shallow soil gas screening level (i.e., >10^{-6} risk, although not greater than 10^{-4}) near an existing occupied building, but this has been acknowledged in the five-year review and is currently being evaluated.

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3.				M.Pierce, CVWB	The information presented in the Draft Report on Sites 57 and 59 is somewhat misleading as it does not cover the recent findings at each site. Site 57 was proposed for closure, but significant rebound of TCE was observed in several vapor monitoring wells in September 2014 and SVE was resumed. At Site 59,TCE concentrations in vapor well 59-PW-07 have been increasing in 2014 prompting the installation of a new nested vapor well near Building 4260 to assess whether vapor intrusion is a concern. The discussion of the actions conducted to date at Sites 57 and 59, including the conclusions/recommendations drawn from the older site data, needs to be revised to reflect the recent soil vapor sample results obtained and decisions made for these two sites.	The text has been updated to acknowledge the ongoing remediation (Site 57) and investigation (Site 59) activities occurring at these sites.
4.	7 and 8			M.Pierce, CVWB	In Sections 7 and 8, the Draft Report implies vapor intrusion from Site 59 into Building 4260 is not a concern because this building is an open hangar. However, the southern end of this building is comprised of offices which may not be well ventilated like the hangar that comprises most of Building 4260. The Air Force needs to revise Sections 7 and 8 to clarify that the southern end of Building 4260 has offices and the potential for vapor intrusion into them needs to be assessed.	The text has been revised to reflect that further investigation and assessment activities are recommended near Building 4260.

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
5.				M.Pierce, CVWB	The Air Force identified perfluorinated compounds (PFCs) as a potential issue during the fourth five-year review period and has submitted a work plan to investigate this emergent chemical during the current five-year review period. Revise the Draft Report to identify PFCs as an issue and add a recommendation to investigate this emergent chemical.	The text has been revised and the recommendation added.
6.				M.Pierce, CVWB	Although most of the former Mather Air Force Base has been transferred to Sacramento County, State Land Use Covenants (SLUCs) have not been executed for every parcel that requires one and Sacramento County has not initiated annual reporting on all parcels that fall under an executed SLUC. Central Valley Water Board staff request that you revise the Draft Report to make this an issue to be addressed during the fifth five-year review period.	The Air Force has placed appropriate restrictions in all transfer documents and has reported compliance with the ICs through 2013. As of 30 September 2014, the only parcels for which ICs are not yet included in deed restrictions are parcels A-2 and G-1c, which are in the process of being deeded from the Department of the Interior to Sacramento County. State Land Use Covenants have, therefore, not been finalized for these two parcels or for Parcel A-1. The Air Force has requested the state to provide copies of compliance reporting required of landowners by SLUCs issued from 2008 onward and expects to receive these for the 2014 reporting period. However, if Sacramento County or other property transferee does not conduct the annual inspection or submit a report to the State, the Air Force is required to do so in accordance with the RODs or post-ROD decision documents (i.e. post-ROD memorandum/ESDs). These documents (continued)

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6. (cont'd)				M.Pierce, CVWB		(continued) generally state that although the Air Force is transferring responsibilities to the transferee and its successors by provisions to be included in the deed(s) transferring title to the property and may contractually arrange for third parties to perform any and all of the actions associated with the ICs, the Air Force is ultimately responsible for the remedy (including ICs) before and after property transfer. The Air Force will exercise this responsibility in accordance with CERCLA and the NCP. Therefore, compliance with the terms of these decision documents will be protective of human health and the environment. Even though SLUCs may not yet have been executed for all transferred parcels or the county or other transferee has not yet provided a compliance report to the state for parcels with executed SLUCs, the Air Force has conducted the monitoring to determine whether the ICs are in place and effective and has reported on the status of the ICs annually since 2010, thereby being in compliance with the terms of the ROD or post-ROD requirements and protective of human health and the environment. From the Air Force's perspective, there is no issue to be added to the five-year review.

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
7.				M.Pierce, CVWB	The Draft Report indicates capture in the southwest lobe of the Main Base/SAC plume may be incomplete and recommends optimizing the extraction rate at MBS EW-13BuB and evaluating capture by collecting semiannual groundwater level measurements during the next five-year review period. Please explain what more can be done to optimize extraction of EW-13BuB since optimization was already conducted after installation of this well in 2007. Also, the recommendation for this issue should be revised to include a trigger for additional actions (installation of an off-site extraction well, in situ remediation,...etc.) if concentrations continue to increase in down gradient groundwater monitoring wells.	The extraction rate at EW-13BuB is limited by the size of the conveyance line and the additional extraction wells that are also connected to that line. The ongoing recommendation to optimize (increase) the flow rate from this well requires either replacing the line or shutting down some of the other wells. The latter option is considerably less expensive than the former, but would reduce extraction at other productive locations. With the shutdown of four extraction wells in March 2014, the flow rate at EW-13BuB was able to be increased approximately 15 gpm to 145 gpm in May 2014. EW-13BuB appears to be providing sufficient capture, which is why the Air Force is continuing to monitor the area with the standing recommendation for a more aggressive approach if deemed necessary. However, concentrations outside of the interpreted capture zone have low and generally decreasing concentrations. No specific criteria have been developed to trigger a more aggressive response except those in the Contingency Plan and such specifics are not considered necessary to develop for the five-year review. Instead, this is a topic more appropriate for ongoing operations as discussed in the quarterly fact sheets and annual reports.

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Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
Specific Comments						
1.	6.1	6-1	Tbl. 6-1	M.Pierce, CVWB	Update the document submission dates and the finalization date presented in this table.	Table 6-1 has been updated.
2.	8.2	8-2		M.Pierce, CVWB	Northeast Plume Issue: Increasing PCE and cis-1,2-DCE concentrations in MAFB-132 and MAFB-398C are identified as the issue here. There is a recommendation to consider installing additional monitoring wells in the area of MAFB-398C if contaminant concentrations in this well continue to increase in 2015. Even though these wells monitor different landfills, there is no corresponding recommendation for monitoring well MAFB-132. Explain why or add a similar recommendation for MAFB-132. In the last sentence of the recommendation revise “consider installing additional monitoring wells...” to “the Air Force will install additional monitoring wells in this area...”.	MAFB-398C (screen interval = -23.65 to -33.65 feet msl) is the deepest well at LF-03. The purpose of the possible recommended (deeper) well would be to define the plume vertically at LF-03. Incidentally, 2Q14 data show that PCE and cis-1,2-DCE are now at concen-trations less than ACLs at MAFB-398C. A similar recommendation for MAFB-132 (screen interval = 39.28 to 24.28 feet msl) at LF-04 is not made because MAFB-400 (screen interval = -13.21 to -23.21 feet msl) is sampled and the results from this well define the vertical extent of contamination at LF-04. Following the discussion at the 27 January TWG meeting, the text related to the Northeast Plume issue/recommendation was removed from Section 8.2 and moved to “Progress Toward Meeting RAOs” in Section 7.3.3.1. Minor revisions to the text were made to accommodate this move.

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Specific Comments						
1.	3.1.1	3-1		C.Tsao, T. Nakahara, F&W	*Surface Water Hydrology*. Please provide a copy of the most recent formal wetland delineation of Mather to CDFW-OSPR for review.	A copy of the most recent formal wetland delineation of Mather was provided for reference to T. Nakahara, CDFW, by Sacramento County in November 2014.
2.	4.2.1, 4.3.1, 4.3.2	4-14, 4-21, 4-22		C.Tsao, T. Nakahara, F&W	*Section 4.2.1 Site WP-07/FT-11; Section 4.3.1 Site LF-03; and, Section 4.3.2 Site LF-04*. Under the subsections "*Remedy Implementation*" for these sites, please explain whether burrowing animal control is being conducted at any of these sites, as part of the post-closure inspections and maintenance of the caps. If control is being conducted, please identify the species controlled and the methods used. If burrowing animal control is being conducted at these sites, CDFW-OSPR requests to review copies of the quarterly field logs and annual post-closure landfill inspection reports to determine if impacts are occurring to non-target special status species from control activities. CDFW-OSPR requests the Air Force consult with CDFW-OSPR and the United States Fish and Wildlife Service (USFWS) to determine appropriate control methods, as well as avoidance and minimization measures for special status species.	Burrowing animal control is not being conducted at Sites WP-07, LF-03, or LF-04. To date, only minimal burrowing has been observed during quarterly landfill inspections, and there have been no breaches of the cap liners. When a hole from a burrowing animal is observed on the cap, soil is removed to evaluate the condition of the cap liner, and then the hole is backfilled and compacted to the surrounding grade.

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3.	4.3.1	4-21		C.Tsao, T. Nakahara, F&W	*Section 4.3.1 Site LF-03, Subsection Remedy Implementation*. The text states, "*The SLUC* [State Land Use Covenant] *requires or will require the new property owner to conduct annual IC* [Institutional Control] *inspections and to report on those inspections to the state until the ICs at the site are terminated. As of June 2014, the state had not received a compliance report from the new landowner, Sacramento County*." Please explain what will happen if the Sacramento County does not conduct annual IC inspections or submit a report to the State.	If Sacramento County does not conduct the annual inspection or submit a report to the State, the Air Force is required to do so in accordance with the *Memorandum of Post-ROD Changes, Clarification of Institutional Controls for the Landfill Operable Unit Remedies* (AFRPA, 2009). The sentence that follows the text noted in the comment says: "However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer." Although a SLUC has been in place for parcel A-3, which includes Site LF-03 (see revised Figure 2-1), since June 2013, a compliance report has not been received by the state. Consequently, the Air Force included Site LF-03 during their 2013 ICs inspections and reported on the inspection in the *2013 Annual Report of Compliance with Institutional Controls at the Former Mather Air Force Base* (AFCEC, 2014).
4.	Fig. 4-17			C.Tsao, T. Nakahara, F&W	*Figure 4-17 Site OT-89 Institutional Control Area*. Please include the "*Approximate Soil Excavation Limit*" on the figure as was done for Site OT-87 on Figure 4-16.	The excavation limits for Site OT-89 have been added to Figure 4-17.

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5.	4.4.5	4-31		C.Tsao, T. Nakahara, F&W	*Section 4.4.5 Site OT-87, Subsection Remedy Implementation*. The text states, "*Through May 2014, no dead waterfowl have been observed at Site OT-87*." Please explain how often the site is inspected for dead waterfowl.	The intent of the Basewide ROD was not to require a formal inspection program but to report to the regulatory agencies if any dead waterfowl are found in the area of Site OT-87. Therefore, routine inspections have not been conducted beyond those conducted for IC compliance. Observations are made when on site for other reasons, but not always documented. However, if any dead waterfowl are found, the Air Force or its contractors will notify the regulatory agencies and the dead waterfowl will be necropsied for signs of lead toxicity in accordance with the Basewide OU ROD. No dead waterfowl have been found during periodic site visits by the Air Force or during the annual ICs inspections at Site OT-87 (URS, 2012 and 2013; AFCEC, 2014).

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6.	7.6.3	7-40		C.Tsao, T. Nakahara, F&W	*Section 7.6.3 Site OT-23C, Subsection Institutional Controls*. The text states, "*In May 2013, a SLUC was executed for this parcel; therefore, the new property owner is required to conduct annual IC inspections and report on those inspections to the state until the ICs at the site are terminated*." Please explain whether the new property owner has conducted the annual IC inspections and sent a report on those inspections to the State.	If the new property owner does not conduct the annual inspection or submit a report to the State, the Air Force is required to do so in accordance with the *Explanation of Significant Difference from the Record of Decision for Basewide Operable Unit Sites: Sites FT-10C/ST-68, LF-18, OT-23C, and OT-87* (AFRPA, 2010). The sentence that follows the text noted in the comment says: "However, under CERCLA, the Air Force is ultimately responsible for implementing, maintaining, monitoring, and reporting on ICs before and after property transfer." Although a SLUC has been in place for parcel P-2, which includes Site OT-23C (see revised Figure 2-1), since May 2013, a compliance report has not been received by the state. Consequently, the Air Force included Site OT-23C during their 2013 ICs inspections and reported on the inspection in the *2013 Annual Report of Compliance with Institutional Controls at the Former Mather Air Force Base* (AFCEC, 2014).
7.	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	*Section 7.6.4.1 Question A: Is the remedy functioning as intended by the decision documents [for Site OT-87]*. a. CDFW-OSPR does not agree with the stated conclusion that "*The remedy is functioning as intended by the Basewide OU ROD (AFBCA, 1998c) and the Basewide OU ESD (AFRPA, 2010b)*" for the following reasons: (continued)	 Comment noted.

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7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	(1) The ROD requires a minimum of three years of monitoring small mammals by trapping and analyzing the lead concentration in their livers and kidneys. The Air Force was not able to capture any small mammals in 2007 and yet identified this as a monitoring year. CDFW-OSPR disagrees with this determination and has documented the disagreement in many review memoranda (Tsao, 2008; Tsao, 2009a, b; Tsao, 2010a; Tsao, 2010b; and Tsao, 2010c). It should be noted in the subject document that the United States Environmental Protection Agency (USEPA), DTSC, and CDFW-OSPR disagree that the Air Force has completed its obligation to monitor the small mammals at Site 87.	The comment is incorrect in stating that the ROD required a minimum of three years of monitoring. The ROD states: "If small mammal tissue lead levels are lower than those reported to cause adverse effects (Eisler 1998) after a minimum of two years of monitoring, then monitoring will be discontinued upon agreement by the regulatory agencies." The monitoring achieved the requirement set forth the ROD. Small mammal tissue lead levels are lower than those reported in Eisler to cause an adverse effect. In addition, several other available benchmarks were evaluated in the monitoring report, and all indicate no adverse effects. Additional monitoring is not likely to provide substantive new information and would result in further impact to the local small mammal population. Further, another round of monitoring does not address the underlying area of disagreement, which is, should kidney tissue data from the 9-month group in Fowler et al. (1980), be used as the sole criteria for determining that the Site 87 remedy is not protective. Thus, additional monitoring is not warranted. Issues pertaining to the kidney tissue data from the 9-month group in Fowler et al. are discussed in the responses to comments below.

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7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	(2) The text states, "*the measured concentrations of lead are within background levels and generally regarded as no adverse effects level…*" It continues, "*Thus, there was no evidence from the 2008 or 2009 monitoring event to suggest that small mammal at Site OT-87 are accumulating lead in their tissues at concentration greater than back-ground levels (MWH, 2010c).*" As we have noted in our review memoranda to DTSC (Tsao, 2008; Tsao, 2009a, b; Tsao, 2010a, b, c), this conclusion is based on lead concentration in whole-bodies, rather than liver or kidney concentrations. We elaborate our disagreement further as follows: (a). In all our memoranda to DTSC regarding tissues (Gray and Stanton, 2006; Tsao, 2008; Tsao, 2009a, b; Tsao, 2010a, b, c), we have maintained that whole body measurement does not provide a meaningful interpretation of the effects to small mammals. In a memorandum to DTSC on the Work Plan, we state, "*DFG-OSPR does not believe that whole body residue data will be* (continued)	The comment incorrectly states that the conclusions of the small mammal monitoring report are based on whole body vs. liver or kidney concentrations. The conclusions are based primarily on comparison of kidney and liver concen-trations with applicable comparative values available in the literature. In keeping with the responses to agency comments on the report, the comparison of whole body concentrations are included in the document under "Secondary Lines of Evidence."

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Comment Number	Section	Page	Paragraph	Reviewer	Comment	Response
7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	(continued) *valuable in interpreting adverse impacts in small mammals*" (Gray and Stanton, 2006). Earlier in 2009, in a draft memorandum to DTSC (Tsao, 2009a), we stated, "*DFG-OSPR's recommendation to DTSC will be based on kidney and liver concentration*." Our ongoing recommendation has always been to use liver and kidney concentrations and not whole body concentrations. This is because the liver and kidney accumulate lead and reflect recent exposure.	
					(b). The USEPA concurs with CDFW-OSPR that whole-body measurement is not a reliable indicator of effects. In a letter to the Air Force on the Small Mammal Work Plan, USEPA states "*… they [whole body values] cannot be used to predict adverse effects to small mammals*" (Page 4 of 9, Appendix D, Final Small Mammal Monitoring Plan, MWH, 2008).	Please refer to the response to the comment above.

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7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	(c). Above all, the Air Force not only agreed that it would not use whole-body measurements but also stated that it would *"replace"* whole-body measurements with organ-specific measurements. According to the Final Small Mammal Work Plan, the Air Force's response to USEPA's comment was, *"The Air Force is in agreement that sampling and analysis of lead concentrations in specific organs of small mammals is a preferred method for monitoring lead exposures over whole body measurements. Therefore, the Air Force will revise the small mammal monitoring Work Plan to replace [emphasis added] whole body tissue measurements with sampling and analysis of lead in liver and kidney tissues"* (page 4 of 9, Appendix D, Final Small Mammal Monitoring Plan, MWH, 2008). The Air Force acknowledged that *"comparative data in the literature relating to lead tissue concentrations in small mammals that are associated with ambient lead* (continued)	The Work Plan specifies that liver and kidney concentrations will be analyzed because of the availability of comparative data in the literature for these parameters. Liver and kidney data were collected pursuant to the Work Plan, and the conclusions of the report are based primarily on these data. As stated above, a comparison of whole body concentrations is included in the document under "Secondary Lines of Evidence." The purpose of the monitoring is to comply with the requirements of the ROD for Site 87. The ROD specifies that tissue lead levels will be compared to those reported to cause adverse effects in Eisler, 1998. Whole body tissue concentrations are required to conduct this comparison. Again, those comparisons are presented as "Secondary Lines of Evidence." The conclusions of the report are based primarily on the liver and kidney data.

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7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	(continued) *concentrations vs. potentially, toxic levels in soil are more robust for liver and kidney measurements than whole body measurements (Eisler, 1988; Ma 1992, 1996; Chmiel and Harrison, 1981; Getz et al., 1977).”* (d). The Air Force’s decision to abandon whole body measurement was clear in the Air Force’s Small Mammal Monitoring Work Plan. In the response to CDFW-OSPR’s comments, it stated that it would “*replace*” whole-body measurements with organ-specific measurements (page 4 of 12, Appendix D, Final Small Monitoring Plan, MWH, 2008). The Air Force then revised Section 4.0 (Data Collection Procedures) of the Work Plan (MWH, 2008) accordingly. Using whole body measurement as one line of evidence, along with other data (i.e. organ concentrations), does not accurately reflect the Air Force’s intent “*to replace whole-body tissue with sampling and analysis of lead in liver and kidney*.”	 Please refer to the response to the comment above.

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7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	(3) In the Final Results of the 2009 Small Mammal Monitoring Report (MWH, 2010), the Air Force did not use toxicologically-based benchmark values to evaluate small mammal tissue concentrations. However, in 2008, the Air Force already ***concurred*** with CDFW-OSPR's recommended ranges of No Observed Effect Concentration (NOEC) and Lowest Observed Effect Concen-tration (LOEC) for small mammal ***tissue*** concentrations during the work plan comment resolution process. Please see page 3, Appendix D of the Final Small Mammal Monitoring Work Plan (MWH, 2008). Given the Air Force concurred with our recommended values in 2008, these values should continue to be used for comparison by the Air Force in the monitoring reports. In fact, as presented in Attachment 2 of the Draft Final Result of 2008 Small Mammal Monitoring at Site 87 (MWH, 2009; Fortun, 2009), the Air Force used our recommended lead tissue NOEC range of 0.58 – 1.8 mg/kg and LOEC range of 1.1 – 2.1 mg/kg in its analysis of kidney tissue concentrations. Therefore, we believe the Air Force should continue to use of these benchmark values for (continued)	The comment is incorrect. The Air Force did not concur with CDFW-OSPR's recommended No Observable Effect Concentration (NOEC) and Lowest Observable Effect Concentration (LOEC) values, which were derived from Fowler et al. (1980). The Response to Comment on Page 3, Appendix D, of the Final Small Mammal Monitoring Work Plan (MWH, 2008) does not reference the Fowler study or agree to use kidney tissue concentrations from Fowler et al. as benchmark values for Site 87. In fact, it specifically references liver and kidney data in Eisler, 1998, 2000; Ma 1992, 1996; Chmiel and Harrison, 1981; Getz et al, 1977. Consistent with the Response to Comment, the Final Work Plan states "If lead concentrations in small mammal tissues exceed levels reported in the literature to be toxic to small mammals (Eisler, 1998, 2000; Ma 1992, 1996; Chmiel and Harrison, 1981; Getz et al, 1977), then the Air Force will perform small mammal monitoring for an additional one year, in accordance with the ROD (AFBCA, 1998)." (Page 4-7, *Final Small Mammal Monitoring Work Plan*, MWH, March 2008). The monitoring program did not deviate from the Work Plan, but followed it as written.

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7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	(continued) assessing lead hazard to small mammals. We found no reason for the Air Force to deviate from the Work Plan and the subsequent 2008 and 2009 monitoring report, as well as the subject Five-Year Review report. (4) Based on the exceedance of the LOEC kidney concentrations in small mammals collected in 2008 and 2009, we re-iterate our conclusion that the omnivorous small mammal guild, represented by mice, are likely adversely affected by residual lead at Site 87, and this impact may contribute to the limited number of mice found at the site during trapping, especially in 2009. Please see the recommendation section for a suggested path forward on this site.	A detailed evaluation of the issues and uncertainties associated with the NOEC and LOEC values recommended for use by CDFW-OSPR is presented in the responses to comments on the 2009 monitoring report (Pages 2-4, Attachment G, *Final Results of 2009 Small Mammal Monitoring at Site 87*, MWH, September 2010) and at the end of this response to comments. Two sets of NOEC and LOEC values were presented in Fowler et al. (1980) -- one set representing a 6-month group and one set representing a 9-month group. CDFW-OSPR suggests that exceedance of the LOEC values from the 9-month group is an indicator of toxicity. However, the authors of the Fowler et al. study note that the low kidney tissue concentrations from the 9-month group, as compared to the 6-month group, are likely attributable to variability in the data and the small sample size (4 individuals). As shown in Table 1 below, the data from Site 87 do not exceed the LOEC values for the 6-month group in Fowler et al., (continued)

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7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	b. *Subsection: Small Mammal Monitoring.* (1) The text states, "…*there was no evidence from the 2008 or 2009 monitoring event to suggest that small mammals at Site OT-87 are accumulating lead in their tissues at concentrations greater than background levels (MWH, 2010c).*" As stated in the review memoranda, the "*background levels*" were not established prior to the start of the small mammal monitoring program. The Air Force elected to drop reference site comparison in the work (continued)	(continued) which consisted of 12 individuals and provides a more robust and reliable data set for comparison purposes. Further, kidney and liver concentrations from voles and mice at Site 87 are below effect levels presented in Schlick et al., 1998, Eisler, 2000, Ma, 1996, and Mierau and Favara, 1975, and are comparable to or less than background-level kidney and liver tissue concentrations cited in Getz et al. (1977), Chmiel and Harrison (1981), and Johnson et al. (1978). Thus, the data provide substantial evidence that residual lead in soil is not likely to adversely affect small mammal populations at Site 87. Please refer to the responses to comments 7.a. The data indicate that residual lead in soil is not likely to adversely affect small mammal populations at Site 87.

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7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	(continued) plan (MWH, 2008); thus, any claim regarding how tissue collected from Site 87 compares against "background" is not justified. What was agreed upon was the use of toxicity benchmarks to determine if kidney and liver lead concentrations were indicative of adverse effects. (2) The text states, "*In 2009, 28 small mammals, including 3 mice and 25 voles, were trapped. Fourteen of the voles were released (MWH, 2010c).*" Please explain the criteria used to determine the number of voles to be retained, as well as which voles were to be retained (i.e., based on age, size, date trapped, etc.).	 In accordance with the Work Plan, only house mice and deer mice were targeted for collection in 2009. This decision was based on a concern from the agencies regarding possible depletion of the resident vole population due to the lower number of voles captured in previous years (1993 and 2008). All voles initially captured at the site were released. As noted on Page 4 of the 2009 monitoring report, an abundance of voles were trapped in 2009, indicating a larger population than predicted. The Air Force subsequently requested and received concurrence from the agencies to collect voles, and all voles captured after 15 June 2009 were retained. According to the footnotes in Table 1 on Page 5 of the 2009 monitoring report, voles found dead in their traps before this date were also retained. One juvenile vole was captured and retained prior to this date; the reason is not presented in the report and is not known.

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Comment Number	Section	Page	Paragraph	Reviewer	Comment	Response
7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	c. *Subsection: Progress Toward Meeting RAOs.* The text states, *"The small mammal monitoring requirement of the Basewide OU ROD was completed, and results through 2009 indicated that residual lead contamination at Site OT-87 does not pose a potential risk to small mammals (MWH, 2010c). Consequently, small mammal monitoring was discontinued at Site OT-87…"* The USEPA did not agree to discontinue the small mammal monitoring program until the Air Force made six different changes to the document entitled "*Draft, Results of 2009 Small Mammal Monitoring at Site 87*." One of the requirements was for the Air Force to "*delete the discussion of reference values of tissue lead burdens from the literature (or designate this discussion as one of very limited value) unless the study referenced truly reflects local conditions, e.g., rodents in rural areas of the Sacramento Valley with very similar orographic and geologic characteristics*" (USEPA, 2009). To date, we have not received new information on this topic; thus, there is an on-going disagreement with the decision to discontinue the small mammal monitoring program. (continued)	Please refer to the response to comments in the 2009 monitoring report (Pages 1-2, Attachment E, *Final Results of 2009 Small Mammal Monitoring at Site 87*, MWH, September 2010). As discussed above, the data do not suggest an unacceptable risk to small mammals from residual lead contamination at Site OT-87. No further investigation or action is warranted.

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7. (cont'd)	7.6.4.1	7-42		C.Tsao, T. Nakahara, F&W	As described above, CDFW-OSPR strongly disagrees that the remedy at Site OT-87 is protective because the small mammal monitoring data suggests unacceptable risk from residual lead contamination.	Comment noted.
Recommendations						
1.				C.Tsao, T. Nakahara, F&W	Rectify the paragraphs quoted from the subject document as indicated in Specific Comment 7 above so that they are consistent with past correspondence and the regulatory agencies' positions.	See response to comment 7. Section 7.6.4.1 adequately summarizes the small mammal monitoring conclusions and the regulatory agencies' positions.
2.				C.Tsao, T. Nakahara, F&W	Given that there are multiple exceedances of kidney lead concentrations above the agreed upon level for impacts to small mammals, we cannot concur that the remedial action was sufficiently protective of the environment. In order to understand the post-remediation extent of soil contamination, CDFW-OSPR reviewed lead soil concentration data, collected outside the excavated area, from the remedial investigation and remedial action reports (IT, 1997; MW, 1999). These data, along with the approximate excavation footprint, are depicted in Figure 1. Additionally, Pb shot count results from select sampling locations are summarized in Figure 2 of this memorandum. Figure 3 shows sampling locations with respect to the approximate excavation area. According to the USEPA and ITRC, Pb shot can degrade in the environment over time (ITRC, 2003; USEPA, 2003). Moreover, studies have shown that the bioavailability of Pb shot is as high as lead acetate, the most bioavailable form of lead (Bannon et al., 2009). Because Pb shot (continued)	The Air Force does not agree that the remedy is not protective, as reflected in the responses above.

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2. (cont'd)				C.Tsao, T. Nakahara, F&W	(continued) degrades over time, lead soil concentrations may have increased substantially since soil sample collection nearly 20 years ago. In addition, the complete dissolution and release of lead from Pb shot needs to be considered in site cleanup such that the risks to future ecological receptors can be addressed (ITRC, 2003; USEPA, 2003). Given the known fate and biological effects of lead on ecological receptors, we request the following measures to address the residual lead contamination for Site 87: a. ***Collect samples for total lead concentration in soil to understand the extent of residual contamination.*** As Figure 1 indicates, there are many areas that have high residual lead concentrations in soil. In order to better delineate the extent of contamination, we recommend collecting surface soil samples to bound concentrations that are greater than 500 mg/kg lead in soil. Because Pb shot may potentially be present in the samples collected, per the ITRC guidance (ITRC, 2003), the sampling protocol should contain measures to gravimetrically account for Pb shot so that the reported soil concentrations would represent total lead in soil (i.e., report lead concentration in soil as the sum of lead concentration in the soil fraction and mass of lead pellet in soil). To maximize the efficient use of resources, a metal detector capable of detecting Pb shot should be used to guide sampling.	

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2. (cont'd)				C.Tsao, T. Nakahara, F&W	b. ***Collect samples to assess numbers of Pb shot remaining in soil.*** Pb shot degrades in the environment in a site-specific manner. It is not known if all the Pb shot found outside the area of excavation has disintegrated into soil over time (see Figures 2 and 3). According to the Pb shot count and mass data collected at Site 87, each shot averaged a little over 100 grams each. Thus, as little as ten Pb shot in the 1,000 gram sample collected by the Air Force (IT, 1997) would be equivalent to over 1,000 mg/kg of lead in soil (plus background lead). We recommend taking step-out samples for Pb shot in the same manner as was conducted in the remedial investigation (IT, 1997), outside the excavation area. To maximize the efficient use of resources, a metal detector capable of detecting Pb shot should be used to guide sampling. c. **Conduct additional soil removal action(s).** Based on the extent of residual contamination from measures (a) and (b) above, conduct limited soil excavation(s) to remove lead contaminated soil and Pb shot particles from soil. Alternatively, the Air Force may conduct measures (a), (b) and (d). Measure (d) is described in detail as follows:	

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2. (cont'd)				C.Tsao, T. Nakahara, F&W	d. ***Trap deer mice and analyze kidney tissue and/or blood lead levels.*** Based on the kidney and liver concentrations collected from deer mice and voles, it is clear that the herbivorous vole is not accumulating as much lead as the omnivorous deer mouse. The subsequent focus should be on trapping deer mouse (and/or shrew, although shrew would probably be difficult to trap). Previously, CDFW-OSPR recommended that the average 1.6 (range 0.58 – 1.18) mg/kg wet weight kidney lead concentration that corresponds to the Lowest Observed Adverse Effect Level (LOAEL) for organ toxicity (Fowler, 1980; Anderson, 2002) be used for the small mammal monitoring (Gray and Stanton, 2006). As stated in Specific Comment 7a, the Air Force subsequently concurred with this value in the Small Mammal Work Plan (MWH, 2008). In addition to organ sampling, lead analysis of blood, hair, and feather samples is commonly done and has been shown to correlate with concentrations of lead in soil or prey (Eisler, 2000; Pattee and Pain, 2003). For mammals, the LOAEL from the Fowler (1980) study corresponds to a blood lead level of 21 µg/dL. CDFW-OSPR would accept the use of 21 µg/dL as an alternative measure of adverse effects.	
Editorial Comment						
1.				C.Tsao, T. Nakahara, F&W	*Appendix C, Interview Records*. The "*Former Mather AFB* [Air Force Base] – *Fourth Five-Year Review Interview Questionnaire*" for William T. Hughes is included twice.	The duplicate interview questionnaire has been deleted.

The following table is part of the response to comment 7.a.(4):

Table 1. Kidney Tissue Concentrations – Site 87 vs. Fowler et al. (1980)

	Site 87	Lowest Observable Effect Concentration (LOEC) Fowler et al. (1980)	
	95% UCL	6-month group (12 individuals)	9-month group (4 individuals)
Voles	1.1 mg/kg	2.2 –10 mg/kg	1.1 – 2.1 mg/kg
Mice	2.3 mg/kg	2.2 – 10 mg/kg	1.1 – 2.1 mg/kg

95% UCL = 95% upper confidence limit on the mean kidney concentration

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				DTSC GSU	The Air Force (AF) has addressed all of the Department's comments with the exception of comment #5d (from Jeff Brown, GSU). The comment requested the FYRR be revised to make the topic of vapor intrusion risk evaluations for current and future workers in existing buildings a formal issue in the document. The AF did not concur with the request to revise the FYRR on this topic; on the basis they remain committed to evaluate vapor intrusion risk to current workers. The Department will reserve its decision on the adequacy of the AF's response pending a discussion of the recent shallow soil gas sampling results for Building 4260 (Site 59) and course of action at our next Mather BRAC Cleanup Team meeting on June 10, 2015.	It is not clear whether the 10 June 2015 BCT meeting resolved this comment for DTSC GSU. However, the Air Force has not changed its response and believes that vapor intrusion risks are adequately addressed by the existing SVE remedies and evaluation procedures and should not be an issue in the FYRR. Note that the Air Force collected photoionization detector (PID) measurements in Building 4260 on 29 June 2015 to assess indoor air VOC concentrations in view of the elevated shallow (less than 20 feet deep) soil gas VOCs noted in the recently installed vapor wells located near the building, especially at 59-PW-12A and PW-12B. No breathing zone PID VOC concen-trations were greater than 0.6 ppmv and outside ambient air background levels were measured at 0.2 to 0.3 ppmv. Therefore, there appears to be no significant vapor intrusion risk in this building. This effort may be considered an example of why the Air Force believes potential vapor intrusion risks to current workers are being adequately addressed.

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				K.Gettmann, DTSC GSU HERO	**SCOPE OF REVIEW:** HERO's review focused on the responses to our February 11, 2015 and October 22, 2014 memorandum and the revisions to the Report concerning human health risk assessment. **CONCLUSIONS** HERO reviewed the April 2015 Draft Final Fourth Five-Year Report, Former Mather Air Force Base, Former Mather Air Force Base, Sacramento, as it relates to human health risk assessment. In general, all of HERO's comments discussed in our October 22, 2014 and February 11, 2015 have been adequately addressed and incorporated into the April version of the document. However, during HERO's review, the newly added text on page 7-49, Section 7.64.2, is not accurate. The text states, "For Site OT-87, results indicate the following: Inside the IC [institutional control] area, the 95th UCL [upper confidence limit] is 254.1 mg/kg. Outside the IC area, the 95th UCL is 41.1 mg/kg. Both of these concentrations are less than the residential CHHSL [California Human Health Screening Level] of 80 mg/kg." Please note that both of the values are not less than the CHHSL, only the 95th UCL for the area outside the IC. Please revise for accuracy. HERO recommends addressing the mirror inconstancy in the April 2015 version. Otherwise, HERO concurs with the Fourth Five-Year Report for Mather Air Force Base.	The text has been changed to read, "For Site OT-87, results indicate the following: Inside the IC area, the 95^{th} UCL is 256.7 mg/kg, which is less than the industrial CHHSL of 320 mg/kg. Outside the IC area, the 95^{th} UCL is 41.1 mg/kg, which is less than the residential CHHSL of 80 mg/kg."

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Response to Air Force's RTCs on Specific Comments on Draft Fourth Five-Year Review						
1.				T.Nakahara, C.L. Tsao, F&W	*Response to Specific Comment 5. Page 4-33, Section 4.4.5 Site OT-87, Subsection Remedy Implementation*. The Air Force responded, "*The intent of the Basewide ROD was not to require a formal inspection program but to report to the regulatory agencies if any dead waterfowl are found in the area of Site OT-87. Therefore, routine inspections have not been conducted beyond those conducted for IC compliance. Observations are made when on site for other reasons, but not always documented*." CDFW-OSPR requests the Air Force develop and implement a more robust waterfowl monitoring plan in coordination with the regulatory agencies, to ensure that the remedy is still protective of natural resources. The current method of monitoring for dead waterfowl is not adequate for determining impacts to waterfowl, as carcasses are likely to decompose or be consumed by scavengers before they are observed "*when on site for other reasons*". Additionally, if dead waterfowl were observed and not documented, the Air Force is not complying with the "*intent of the Basewide ROD*." The ROD states, "*The details of the monitoring program will be worked out cooperatively between the Air Force and the regulatory agencies*" (page 2-64). The Air Force has not coordinated with CDFW-OSPR nor have we concurred with any details of the waterfowl monitoring program currently being implemented by the Air Force.	The Record of Decision (ROD) for the Basewide Operable Unit Sites (AFCEE, 1998) required that the Air Force conduct monitoring of lead levels in small mammal tissue from Site 87. In addition, the ROD specified that any dead waterfowl "found in the area of Site 87" must be reported to the regulatory agencies and necropsied. These requirements are re-iterated in the Small Mammal Monitoring Work Plan (MWH, 2008). At no point during preparation of the ROD or work plan did anyone at the Air Force or the regulatory agencies interpret this to mean that a monitoring plan was needed to specify how dead waterfowl "found in the area of Site 87" would be reported and necropsied. There has been ample opportunity for any dead waterfowl at Site 87 to have been discovered and reported. As previously noted, general field monitoring has been conducted by the Air Force at Mather for over 16 years since the ROD was issued. In addition, field crews and biologists were on-site regularly between July 1998 and July 1999 to perform remedial action pre-construction surveys, construction/site monitoring, and site restoration. The site was also visited twice per day for approximately 20 to 30 days during the (continued)

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1. (cont'd)				T.Nakahara, C.L. Tsao, F&W		(continued) 2007, 2008, and 2009 small mammal monitoring surveys. No dead waterfowl have ever been found by the Air Force in the Site 87 area. There is no evidence that residual lead at Site 87 represents a hazard to waterfowl. However, in accordance with the ROD, if dead waterfowl are found in the Site 87 area, they will be reported to the regulatory agencies and necropsied by the Air Force.

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2.				T.Nakahara, C.L. Tsao, F&W	*Response to Specific Comments 7 and Recommendations 1 and 2*. The response is not acceptable for the following reasons:	
					• CDFW-OSPR does not agree with the Air Force that that the remedy is functioning as intended by the Basewide OU ROD (AFBCA, 1998). The previous small mammal monitoring effort has exceeded the agreed-upon Lowest Observed Adverse Effects Level, which strongly indicates small mammals are being adversely affected by residual lead in the environment.	Small mammal tissue concentrations at Site 87 did not exceed agreed-upon effect levels. The agreed-upon effect levels are those cited in the ROD, which states that small mammal tissue lead levels would be compared to adverse effect levels in Eisler, 1998. Liver and kidney tissue concentrations in all 21 mice and voles collected from Site 87 were found to be lower than the corresponding effect-based concentrations reported in Eisler (1998). In addition, lead levels in small mammal tissues from Site 87 were found to be lower than other effect-based levels available in the literature, and were comparable to or less than background levels found in small mammal tissues from uncontaminated sites in several other studies. All of these (continued)

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2. (cont'd)				T.Nakahara, C.L. Tsao, F&W	 • CDFW-OSPR also identified areas for additional step-out sampling for total lead in soil and for quantity of lead shot in soil in our previous memorandum (Tsao and Nakahara, 2014) because the high concentrations of lead in soil are not delineated. The Air Force did not accept this recommendation.	(continued) data support the conclusion that residual lead at Site 87 is unlikely to have adverse effects on small mammals. The kidney tissue concentration suggested for use by CDFW as the Lowest Observed Adverse Effect Level was considered, but was not agreed upon due to the significant level of uncertainty associated with that value. Those uncertainties are discussed in detail in previous documents and responses to comments. Contaminant concentrations at Site 87 were thoroughly investigated and delineated during three phases of remedial investigations (ITIR, MWH, 1999). The original 1996 site investigation included shot counts and analytical soil sampling over the surface of the former range. Lead shot contour and lead isoconcentration contour maps were prepared to show the distribution of contamination. Only two locations had soil lead concentrations greater than the cleanup level (700 mg/kg). Both were located in areas with lead shot counts of 100+. Phase I and Phase II Preliminary Definition Investigations (PDIs) were conducted to further characterize the vertical and lateral (continued)

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2. (cont'd)				T.Nakahara, C.L. Tsao, F&W		(continued) extent of contamination. Details regarding those investigations and the results can be found in the ITIR (MWH, 1999). The confirmation sampling results shown in Figure 1 of the CDFW letter were not intended to delineate the lateral extent of contamination as suggested. Confirmation samples were collected to verify that cleanup levels had been achieved at the bases of the excavations.
					• Lead shot was left in place that would continue to degrade into the environment in an uncontrolled manner. Some of this residual lead shot can result in soil concentrations of 8,500 mg/kg or possibly higher (assuming total degradation of lead shot to the environment). The Air Force did not accept this recommendation.	The assumption that residual lead shot could result in soil lead concentrations of 8,500 mg/kg or higher is not supported by the data. As noted above, only two locations were found during the initial site investigation to have soil lead concentrations greater than the cleanup level (700 mg/kg). Both were located in the areas with lead shot counts of 100+. During the Phase I PDI, samples were collected from three trenches positioned within and outside of the 100+ shot count contour. The sampling was performed by compositing soil scraped from long shallow trenches to reduce the variability of the results and to delineate the area of contaminant concentrations above site cleanup levels. Unlike the original field investigation, samples were not sieved (continued)

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2. (cont'd)				T.Nakahara, C.L. Tsao, F&W		(continued) prior to chemical analysis, to better represent actual field conditions. The sampling identified concentrations greater than the cleanup goal in Trenches 1 and 2 (both within the 100+ contour). At Trench 3, located between the 10- and 100-foot shot count contours, the average total lead concentration was approximately 27 mg/kg in soil between 0 and 6 inches bgs. This concentration is substantially lower than the ecological screening level for lead of 50 mg/kg (Basewide Operable Unit ROD, Appendix C, Ecological Risk Assessment). These data show that soil lead concentrations in low to moderate shot count areas are unlikely to reach levels of concern for ecological receptors.
					Thus, CDFW-OSPR strongly maintains our recommendation in pursuing a third year of monitoring, using our previously recommended Lowest Observed Effects Concentration (LOEC) range in kidney tissue concentration for lead and/or blood lead level, as alternative measure for adverse effects for small mammals.	Small mammal trapping was conducted for a total of three years, 2007-2009. Although the 2007 trapping effort resulted in no captures, a total of 21 small mammals were collected from Site 87 in 2008 and 2009. Based on comparison with the effects based concentrations in Eisler (1998), as well as other relevant and appropriate benchmark values available in the literature, the data indicate that the remedy is protective of small mammals at the site. (continued)

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2. (cont'd)				T.Nakahara, C.L. Tsao, F&W		(continued) The Air Force conducted a detailed evaluation of the kidney tissue concentration recommended as a Lowest Observed Effect Concentration by CDFW. Due to significant uncertainties associated with that value, as acknowledged by the author of the study, it is not appropriate for use in predicting adverse effects. In all, 21 small mammals from Site 87 were trapped and analyzed for lead tissue levels. The Air Force believes that additional trapping and sacrifice of small mammals from Site 87 would have more impact than benefit, as it is unlikely to provide new information or substantially different results from those already obtained.
Response to Air Force's RTCs on Editorial Comments on Draft Fourth Five-Year Review						
1.				T.Nakahara, C.L. Tsao, F&W	*Response to Editorial Comment 1 on the Draft Fourth Five-Year Review*. *Appendix C, Interview Records*. The "*Former Mather AFB* [Air Force Base] *– Fourth Five-Year Review Interview Questionnaire*" for William T. Hughes is still included in the document twice. Please remove the duplicate questionnaire as previously agreed upon in the Air Force's RTCs.	The redundant pages have been removed.

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Specific Comments on the Draft Final Fourth Five-Year Review						
1. (cont'd)	Tbl. ES-11	ES-9		T.Nakahara, C.L. Tsao, F&W	a. Header states "*Remedial Action Objectives.*" CDFW-OSPR was unable to identify any stated Remedial Action Objectives in the 1998 Basewide OU ROD (AFBCA, 1998). Please identify the source for these Remedial Action Objectives. b. Column under "*Remedy*" for Site OT-87. (1) The table states "*Separation of lead shot.*" Please explain what this means. Although the ecological risk assessment for Site OT-87 predicts that the removal of the top 5-inch to 1-foot of soil would remove lead shot (AFBCA, 1998), such excavation was not lead-shot-based; and excavation only occurred on certain areas of Site OT-87.	The ROD does not explicitly describe remedial action objectives for Site OT-87. However, page 2-62 of the ROD states, "The basis for cleanup is protection of human health, groundwater and surface water quality, and ecological receptors." This text is deemed equivalent to remedial action objectives. (1) Lead shot was separated from excavated soil and the lead shot was recycled as part of the remedy.

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1. (cont'd)	Tbl. ES-11	ES-9		T.Nakahara, C.L. Tsao, F&W	(2) According to the 1998 Basewide OU ROD, one of the remedies for Site OT-87 is to "*perform monitoring to insure that the residual levels of lead left in place at Site 87 do not represent a hazard to small mammals and waterfowl*." It continues, "*…The Air Force may have to undertake additional remedial action to reduce lead levels at Site 87*." Thus, because the monitoring may lead to additional remedial action, please list monitoring of small mammals and waterfowl as part of the overall remedy. c. Column under "*Remedy Status*" for Site OT-87. (1) The table states "*excavation complete*." The excavation may not have been completed because additional lead shot still remains and is continually degrading into the environment. As CDFW-OSPR has explained in the previous memo-randum (Tsao and Nakahara, 2014), assuming complete degradation, it follows that each of these lead shot sampling locations that found 62, 78, 16, and 18 lead shot would constitute 6200 mg/kg, 7800 mg/kg, (continued)	(2) Confirmatory small mammal monitoring and reporting of dead waterfowl were a component of the remedy and have been added to Table ES 1. (1) The selected remedial action for Site 87 was excavation of soil to achieve a cleanup level of 700 mg/kg for the site. Because soil lead concentrations above 700 mg/kg were associated with areas of 100+ shot counts, the remedial action excavation generally followed the 100+ shot contour line. As noted above, the average soil lead concentration between the 10- and 100-foot shot contours from 0 – 6 inch depth was 27 mg/kg, substantially lower than the cleanup level (continued)

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1. (cont'd)	Tbl. ES-11	ES-9		T.Nakahara, C.L. Tsao, F&W	(continued) 1600 mg/kg, and 1800 mg/kg lead in soil. This is because each shot averages a little over 100 mg each, so for every 1,000 gram sample collected in the remedial investigation (IT, 1997), the conversion from lead shot to soil lead concentration would be multiplied by 100 (as in 100 mg lead per lead shot divide it by 1,000 mg soil sample). (2) Since the Air Force has already acknowledged "*the regulatory agencies believe more data are needed to be able to determine protectiveness*" (p. ES-3 of the subject document), CDFW-OSPR recommends that the Air Force add under this column, "*regulatory agencies recommend additional year of small mammal monitoring*" to be consistent with the statement made on page ES-3.	(continued) of 700 mg/kg. Attempting to locate and remove lead shot from low shot count areas would not be practicable and would not substantially increase the protectiveness of the remedy. The remedial action objectives of the ROD were attained, and further excavation is not required or warranted. (2) The referenced text on page ES-3 has been deleted, as Site OT-87 has been deleted from this section because it is not deemed an issue of concern. Therefore, Table ES-1 was not revised to add the suggested wording.
2.		ES-11		T.Nakahara, C.L. Tsao, F&W	*Section Issues of Concern/Next Steps*. a. Please correct the sub-heading "*Site OT-97 Issue (OU 5, Basewide OU)*" to read "*Site OT-87 Issue…*"	 (a) Site OT-87 has been deleted from this section because it is not deemed an issue of concern.

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2. (cont'd)		ES-11		T.Nakahara, C.L. Tsao, F&W	b. The text states, "*The US EPA will coordinate with the State of California to propose a path forward for resolving the disagreement*." This text should be updated. In an email to the Air Force on April 29, 2015, the US EPA stated that "*it is appropriate to conduct a third round of small mammal sampling at this time*." Please update the text to state "*regulatory agencies recommend additional year of small mammal monitoring*."	(b) This text has been deleted because Site OT-87 is not deemed an issue of concern.
3.	Tbl. 1-1	1-6		T.Nakahara, C.L. Tsao, F&W	*Installation Restoration Program Sites that Require a Five-Year Review*. Under the "*Comments*" column, the table states, "*Excavation and soil stabilization; small mammal monitoring completed in 2009*." CDFW-OSPR disagrees that small mammal monitoring has been completed. Please see Specific Comments 2b, 7, and 9 on the Draft Final Fourth Five-Year Review.	The Air Force believes small mammal monitoring has been completed.
4.	2.6.4	2-10		T.Nakahara, C.L. Tsao, F&W	*Site OT-87*. a. The text states, "*The Basewide OU ROD also requires evaluation of any dead waterfowl found at the site*." Please revise the text to state, "*The Basewide OU ROD also requires that any dead waterfowl found in the area of Site 87 must be reported to the regulatory agencies, and necropsied by a certified laboratory for signs of lead toxicity. The details of the monitoring program will be worked out cooperatively between the Air Force and the regulatory agencies.*" Please see Response to Specific Comment 5 on the Draft Fourth Five-Year Review.	 (a) See response to comment 1 on the Draft Final Five Year Review above.

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4. (cont'd)	2.6.4	2-10		T.Nakahara, C.L. Tsao, F&W	b. The text states, "*ICs are in place as part of the remedy to prevent health risks from exposure to soils contaminated with lead*." Please revise the text to state, "*ICs are in place as part of the remedy to prevent human health risks*…" ICs will not prevent ecological receptors from being exposed to soils contaminated with lead.	(b) Requested clarification has been made.
5.	7.6.4.1	7-48		T.Nakahara, C.L. Tsao, F&W	*Question A: Is the remedy functioning as intended by the decision documents?*" The text states, "*The Basewide OU ROD also requires regulatory agency notification if any dead waterfowl are found in the area of Site OT-87, and if any are found, they must be necropsied by a certified laboratory for signs of lead toxicity*." Please add the following text, "*The details of the monitoring program will be worked out cooperatively between the Air Force and the regulatory agencies*." Please see Response to Specific Comment 5 on the Draft Fourth Five-Year Review.	See response to comment 1 on the Draft Final Five Year Review above
6.	Tbl. 8-1	8-4		T.Nakahara, C.L. Tsao, F&W	*Issues Identified During This Five-Year Review, Recommendations, and Follow-Up Actions*. The dates listed under the heading "*Milestone Date*" vary in format. Please revise the entries to use the same format.	The entries have been revised to use the same date format.

RESPONSES TO COMMENTS DRAFT FINAL FOURTH FIVE-YEAR REVIEW, MATHER AFB						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
7.	4.4.5	4-33 and 4-34		T.Nakahara, C.L. Tsao, F&W	*OT-87*. a. *Remedy Section*. In the second paragraph, CDFW-OSPR recommends the Air Force to add the following sentence (taken from the 1998 Basewide OU ROD) at the beginning of the paragraph to provide additional context on the regulatory requirement for small mammal monitoring: *To ensure that the residual levels of lead left in place at Site 87 do not represent a hazard to small mammals and waterfowl, monitoring of lead levels in small mammal tissue will be required on an annual basis for three years.*	(a) This section already discusses the small mammal and waterfowl monitoring, as indicated in this existing text: "The Basewide OU ROD also requires monitoring to insure that the residual levels of lead left in place at Site OT-87 do not pose a hazard to small mammals and waterfowl. To accomplish this task, monitoring of lead levels in small mammal tissue is required on an annual basis for 3 years, with the results evaluated in an annual monitoring report to the regulatory agencies. In addition, any dead waterfowl found in the area of Site 87 must be reported to the regulatory agencies, and necropsied by a certified laboratory for signs of lead toxicity." Therefore, Section 4.4.5 has not been revised.

RESPONSES TO COMMENTS
DRAFT FINAL FOURTH FIVE-YEAR REVIEW, MATHER AFB

Comment Number	Section	Page	Paragraph	Reviewer	Comment	Response
7. (cont'd)	4.4.5	4-33 and 4-34		T.Nakahara, C.L. Tsao, F&W	b. *Remedy Implementation*. The text states, "*Remediation activities at Site OT-87 commenced in August 1998 and were finished when site restoration was completed in July 1999*." CDFW-OSPR would like to clarify that the remediation activities were not finished in July 1999 because in the 1998 Basewide OU ROD, part of the remedy was to perform small mammal monitoring. If the small mammal monitoring is not yet finished, the excavation portion of the remedial activities might be completed for the time-being, but the remedy is not likely completed. c. Under *Remedy Implementation*, the text states, "*The Air Force concluded that residual lead concentrations in soil do not indicate the potential for adverse effects on small mammal populations and discontinued small mammal monitoring at Site OT-87*." To be consistent with page ES-3, CDFW-OSPR recommends the Air Force to add "*the regulatory agencies believe more data are needed to be able to determine protectiveness.*"	(b) The required remediation activities were completed, including small mammal monitoring, hence the statement. If additional remediation activities are found necessary in the future, the status will be updated in a future five-year review. (c) Page ES-3 has been edited to remove this as an issue. Therefore, the reference text in Section 4.4.5 has not been changed.

RESPONSES TO COMMENTS DRAFT FINAL FOURTH FIVE-YEAR REVIEW, MATHER AFB						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
8.	7.1.2	7-3		T.Nakahara, C.L. Tsao, F&W	*Are the toxicity data used at the time of the remedy still valid?*" The text states, "*For OT-87, the 95th UCL* [Upper Confidence Limit] *from the area covered by the ICs is 254.4 mg/kg*." CDFW-OSPR believes that the 95th UCL of 254.4 mg/kg is biased low for the following reasons: a. According to Figures 1, 2, and 3 from the previous review memorandum (Tsao and Nakahara, 2014) and attached herein for easy reference, lead in soil has not yet been fully bounded in many areas (See Figure 1 in the attachment). This means that the upper-end of the distribution for calculating the 95th UCL has not been determined, and therefore, calculation for the 95th percent UCL on the mean, although can be mechanically calculated, is not relevant for exposure assessment.	(a) The statistics commented upon were specifically calculated for the area inside the IC boundary, and the area outside the IC boundary, to be compared to human health benchmarks for industrial (for area where ICs prevent residential use) and residential uses. As discussed in the prior responses to comments, lead concentrations above the site cleanup level were bounded during the site remedial investigations. Figure 1 shows only the confirmation sampling data, which was collected to measure concentrations at the bases of the remedial action excavation areas. Incorporating soil lead values from locations beyond the boundaries of the excavation areas would bias the UCL downward, as soil lead levels have been shown to decrease substantially with distance from the firing stations.

RESPONSES TO COMMENTS
DRAFT FINAL FOURTH FIVE-YEAR REVIEW, MATHER AFB

Comment Number	Section	Page	Paragraph	Reviewer	Comment	Response
8.	7.1.2	7-3		T.Nakahara, C.L. Tsao, F&W	b. CDFW-OSPR ran a spot check of the soil data that went into the 95th UCL calculation and found that the following residual soil lead concentration samples are missing from the calculation (Table 6-9, MW, 1999): • 87-CNFB01-SO-RX: 575.1 mg/kg • 87-CNFB17-SO: 513.2 mg/kg • 87-CNFB02-SO-RX: 849.9 mg/kg	Two of the three locations identified had duplicate samples and the third incorrectly had used the XRF value without a correlation factor. All three locations, however, were represented in the data set used to calculate the statistic. The data set was checked, and a total of four locations were corrected to reflect higher lead values. One value was found with lower laboratory result than XRF result, but the XRF value was retained for conservatism.
					c. In addition, it appears readings from the X-Ray Fluorescence (XRF) meter were used for the 95th UCL calculation. This is not a valid approach. The US EPA recommends 20% of the samples be analyzed by both the XRF instrument and a Contract Laboratory Program to develop a site-specific statistical relationship between the two methods (US EPA, 2003). If the statistical relationship is significant, the instrument reading can then be adjusted and used quantitatively. CDFW-OSPR does not recommend that non-calibrated readings from the XRF instrument be used quantitatively as if they were certified laboratory results without adjustment. Alternatively, results from the (continued)	(c) The appropriate correlation as suggested had been made, with 31% of the sampled evaluated by both the XRF instrument and a Contract Laboratory Program to develop a site-specific statistical relationship between the two methods. However, a figure compiling sampling data had inadvertently included some of the unadjusted XRF values, and four of these unadjusted values had been used in the statistical calculation. Using the corrected data set increased the 95% UCL estimate from 254.4 mg/kg to 256.7 mg/kg.

RESPONSES TO COMMENTS DRAFT FINAL FOURTH FIVE-YEAR REVIEW, MATHER AFB						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
8. (cont'd)	7.1.2	7-3		T.Nakahara, C.L. Tsao, F&W	(continued) XRF readings can be discarded and only results from Method 6010 be used in the 95th UCL calculation (assuming that the site is well delineated). Note that results from Method 6010 are almost always higher than XRF instrument readings. d. It is likely that the upper end of the lead distribution is higher than the highest reported given that the degradation from lead shot in soil has **not** been considered in the 95th UCL calculation on the mean. However, the Air Force has quantified lead shot in its 1996 soil characterization so it should be incorporated into the 95th UCL calculation on the mean. When it does, it would likely find that the 95th UCL would be much higher than 254.4 mg/kg (See Specific Comments 8a, b, and c on the Draft Final Fourth Five-Year Review).	 (d) See responses above.
9.	8.3	8-3		T.Nakahara, C.L. Tsao, F&W	*Basewide OU.* Under Recommendation, the text states, "*The U. S. EPA will coordinate with the State of California to propose a path forward for resolving the disagreement*." Please replace this with the US EPA's recommendation on conducting an additional year of small mammal monitoring. (continued)	See responses to specific comments on these concerns.

RESPONSES TO COMMENTS DRAFT FINAL FOURTH FIVE-YEAR REVIEW, MATHER AFB						
Comment Number	**Section**	**Page**	**Paragraph**	**Reviewer**	**Comment**	**Response**
9. (cont'd)	8.3	8-3		T.Nakahara, C.L. Tsao, F&W	(continued) **Conclusion** The current method of monitoring for dead waterfowl is not adequate for determining impacts to waterfowl, therefore, CDFW-OSPR strongly recommends the Air Force develop and implement a more robust waterfowl monitoring plan in coordination with the regulatory agencies, to ensure that the remedy is still protective. The 95th percent UCL on the mean cannot be meaningfully calculated because the site is not yet fully delineated. CDFW-OSPR recommends that additional step-out samples for lead in soil and lead shot quantitation be conducted. Previously, CDFW-OSPR asserted that based on the small mammal monitoring data collected in 2008 and 2009, the data indicated an unacceptable hazard to small mammals from residual lead. CDFW-OSPR is willing to withhold the assertion and recommend another year of small mammal monitoring as it would be consistent with the 1998 Basewide OU ROD. Any statement that asserts that the remedy is protective of ecological receptors for Site OT-87 should state that such charac-terization is pending until a third year of small mammal monitoring is completed.	 The Air Force believes the current method of monitoring for dead waterfowl is adequate to ensure the remedy is still protective. See above responses. The Air Force believes the site is adequately characterized. See above responses.

APPENDIX D

Lead 95 Upper Confidence Limit Calculations and Blood Lead Level Estimates

Site 10C/68 residual lead

Sample	Result total lead (mg/kg)
10C68-Pb-1-SO	113
10C68-Pb-2-SO	62
10C68-Pb-3-SO	10.3
10C68-Pb-4a-SO	12.7
10C68-Pb-4b-SO	10.9
10C68-Pb-5-SO	11
10C68-Pb-6-SO	24.1
10C68-Pb-7-SO	14.1
10C68-Pb-8-SO	9.9
10C68-Pb-9-SO	27.2
10C68-Pb-10-SO	105
10C68-Pb-11-SO	127
Arithmetic mean	43.93
normal?	no (Shapiro-Wilk)
t value	1.795884819

Shapiro-Wilk
n=12, m=6

Lead	Sorted	n			diff
113	9.9	a1	0.5475	x12-x1	117.1
62	10.3	a2	0.3325	x11-x2	102.7
10.3	10.9	a3	0.2347	x10-x3	94.1
12.7	11	a4	0.1586	x9-x4	51
10.9	12.7	a5	0.0922	x8-x5	14.5
11	14.1	a6	0.0303	x7-x6	10
24.1	24.1				
14.1	27.2	SS	22730.01		
9.9	62	b	130.0738		
27.2	105	w=b2/SS	0.744355		
105	113	0.5			
127	127	0.9			
		p-value			

a*diff	
64.11225	
34.14775	
22.08527	
8.0886	
1.3369	
0.303	
130.0738	b=sum (a*diff)

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	4/1/2015 1:35:40 PM
From File	10C-68 lead data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Site 10C total lead (mg/kg)

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	9.9	Mean	43.93
Maximum	127	Median	19.1
SD	45.46	Std. Error of Mean	13.12
Coefficient of Variation	1.035	Skewness	1.066

Normal GOF Test

Shapiro Wilk Test Statistic	0.744	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.31	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.256	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	67.5	95% Adjusted-CLT UCL (Chen-1995)	69.83
		95% Modified-t UCL (Johnson-1978)	68.17

Gamma GOF Test

A-D Test Statistic	1.07	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.255	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.252	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.146	k star (bias corrected MLE)	0.915
Theta hat (MLE)	38.35	Theta star (bias corrected MLE)	48.03
nu hat (MLE)	27.49	nu star (bias corrected)	21.95
MLE Mean (bias corrected)	43.93	MLE Sd (bias corrected)	45.94
		Approximate Chi Square Value (0.05)	12.3
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	11.21

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	78.39	95% Adjusted Gamma UCL (use when n<50)	86

	A–E	F	G–K	L
51	**Lognormal GOF Test**			
52	Shapiro Wilk Test Statistic	0.824	**Shapiro Wilk Lognormal GOF Test**	
53	5% Shapiro Wilk Critical Value	0.859	Data Not Lognormal at 5% Significance Level	
54	Lilliefors Test Statistic	0.234	**Lilliefors Lognormal GOF Test**	
55	5% Lilliefors Critical Value	0.256	Data appear Lognormal at 5% Significance Level	
56	**Data appear Approximate Lognormal at 5% Significance Level**			
57				
58	**Lognormal Statistics**			
59	Minimum of Logged Data	2.293	Mean of logged Data	3.286
60	Maximum of Logged Data	4.844	SD of logged Data	1.025
61				
62	**Assuming Lognormal Distribution**			
63	95% H-UCL	112.8	90% Chebyshev (MVUE) UCL	83.05
64	95% Chebyshev (MVUE) UCL	101.4	97.5% Chebyshev (MVUE) UCL	126.8
65	99% Chebyshev (MVUE) UCL	176.8		
66				
67	**Nonparametric Distribution Free UCL Statistics**			
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**			
69				
70	**Nonparametric Distribution Free UCLs**			
71	95% CLT UCL	65.52	95% Jackknife UCL	67.5
72	95% Standard Bootstrap UCL	64.79	95% Bootstrap-t UCL	78.46
73	95% Hall's Bootstrap UCL	62.14	95% Percentile Bootstrap UCL	64.37
74	95% BCA Bootstrap UCL	68.66		
75	90% Chebyshev(Mean, Sd) UCL	83.3	95% Chebyshev(Mean, Sd) UCL	101.1
76	97.5% Chebyshev(Mean, Sd) UCL	125.9	99% Chebyshev(Mean, Sd) UCL	174.5
77				
78	**Suggested UCL to Use**			
79	95% Chebyshev (Mean, Sd) UCL	101.1		
80				
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
82	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
83	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
84	For additional insight the user may want to consult a statistician.			
85				

LEAD RISK ASSESSMENT SPREADSHEET 8

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Click here for ABBREVIATED INSTRUCTIONS FOR LEADSPREAD 8

INPUT	
MEDIUM	LEVEL
Lead in Soil/Dust (ug/g)	101.1
Respirable Dust (ug/m^3)	1.5

OUTPUT					
Percentile Estimate of Blood Pb (ug/dl)					
	50th	90th	95th	98th	99th
BLOOD Pb, CHILD	0.7	1.3	1.6	1.9	2.1
BLOOD Pb, PICA CHILD	1.4	2.6	3.1	3.8	4.3

EXPOSURE PARAMETERS		
	units	children
Days per week	days/wk	7
Geometric Standard Deviation		1.6
Blood lead level of concern (ug/dl)		1
Skin area, residential	cm^2	2900
Soil adherence	ug/cm^2	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001
Soil ingestion	mg/day	100
Soil ingestion, pica	mg/day	200
Ingestion constant	(ug/dl)/(ug/day)	0.16
Bioavailability	unitless	0.44
Breathing rate	m^3/day	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.192

PATHWAYS						
CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.8E-5	0.01	1%		0.01	0%
Soil Ingestion	7.0E-3	0.71	99%	1.4E-2	1.42	100%
Inhalation	2.0E-6	0.00	0%		0.00	0%

Click here for REFERENCES

	A	B	C	D	E
1	Samples ou	Site 87 outs	Samples ins	Site 87 within IC area	
2	SSA-087-01	13	SSA-087-15	27	
3	SCA-087-04	39	87-CNFB17	400	
4	SSA-087-03	16	87-CNFB18	160	
5	SSA-087-17	65	87-CNFRD8	85	
6	87-CNFL-15	7.9	87-CNFL-27	27	
7	87-CNFL-23	30.1	87-TAF-09	19.5	
8	87-CNFS03	10.6	87-TAF-04	275	
9			87-TAF-16	14	
10			87-TAF-20	9.6	
11			87-TAF-25	114	
12			87-TAF-26	265	
13			87-TAF-14	180	
14			87-TAF-13	16	
15			87-TAF-12	40	
16			87-SPF01	292	
17			87-SPF02	14	
18			87-SPF03	59	
19			87-SPF05	11	
20			87-SPF08	359	
21			87-CNFB15	648.1	
22			87-CNFB14	939.6	
23			87-CNFB20	552.2	
24			87-CNFB22	170	
25			87-CNFB01	640	
26			87-CNFB02	760	
27			87-CNFB03	250	
28			87-CNFB04	82	
29			87-CNFB05	52.8	
30			87-CNFB06	52.8	
31			87-CNFB07	74.6	
32			87-CNFB08	25.3	
33			87-CNFB09	236.6	
34			87-CNFB10	754.5	
35			87-CNFB11	580.4	
36			87-CNFB16	880	
37			87-CNFB21	217.4	
38			87-CNFL01	20.5	
39			87-CNFL02	7	
40			87-CNFL03	9.4	
41			87-CNFL04	7	
42			87-CNFL05	63.7	
43			87-CNFL06	16.9	
44			87-CNFL07	50.4	
45			87-CNFL08	103.9	

	A	B	C	D	E
46			87-CNFL09	36	
47			87-CNFL10	56.4	
48			87-CNFL11	22.9	
49			87-CNFL12	234.1	
50			87-CNFL13	43.2	
51			87-CNFL14	70.3	
52			87-CNFL15	7	
53			87-CNFL16	205.5	
54			87-CNFL17	7	
55			87-CNFL19	21.7	
56			87-CNFL20	90.7	
57			87-CNFL21	198.1	
58			87-CNFL22	210.9	
59			87-CNFL23	30.1	
60			87-CNFL24	66.2	
61			87-CNFL25	26.5	
62			87-CNFL26	7	
63			87-CNFL28	15.7	
64			87-CNFL29	6.4	
65			87-CNFL30	10.1	
66			87-CNFL31	7.9	
67					
68					
69			87-TAF-10	14	
70			87-TAF-19	30	
71			87-TAF-28	17	
72			87-TAF-40	6.5	
73			87-TAF-29	592	
74			87-TAF-30	690	
75			87-TAF-27	237	
76			87-TAF-01	79	
77			87-TAF-02	390	
78			87-TAF-05	538	
79			87-TAF-06	629	
80			87-TAF-17	307	
81			87-TAF-18	24	
82			87-TAF-21	389	
83			87-TAF-24	11.5	
84			87-TAF-31	43	
85			87-TAF-34	574	
86			87-TAF-35	289	
87			87-TAF-36	567	
88			87-TAF-37	488	
89			87-TAF-38	447	
90			87-TAF-39	590	

	A	B	C	D	E
91			87-SPF04	55	
92			87-SPF06	123	
93			87-SPF07	184	
94			87-SPF10	34	
95			87-SPF11	764	
96			87-SPF12	29	
97			87-SPF13	39	
98			87-SPF14	315.2	
99			87-SPF15	567	
100			87-SPF16	464	
101			87-CNFS04	16.3	
102			87-CNFS05	26.6	
103			87-CNFS10	27.9	
104			87-CNFS12	14	
105			87-CNFS16	11.8	
106			87-CNFS17	15.5	
107			87-CNFS18	12.1	
108			87-CNFS19	4.8	
109			87-CNFS25	9.3	
110			87-CNFS26	11.2	
111			87-CNFS27	17.3	
112			87-CNFS28	10.2	
113			87-CNFS29	8.7	
114			87-CNFS30	9.4	
115			87-CNF15-S	7.2	
116			87-CNF16-S	6.7	
117			87-CNF17-S	8.4	
118			87-CNF18-S	8.2	
119			87-CNF19-S	6.2	
120			87-CNF20-S	26.6	
121			87-CNF21-S	6.9	
122			87-CNF22-S	6.8	
123			87-CNF23-S	64.5	
124			87-CNFRD1	110	
125			87-CNFRD2	16	
126			87-CNFRD3	15	
127			87-CNFRD4	25	
128			87-CNFRD5	12	
129			87-CNFRD6	180	
130			87-CNFRD7	76	
131			87-CNFRD8	85	

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	4/1/2015 4:58:33 PM
From File	Site 87 lead data for ProUCL stats calculation wth 04-01-15.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Site 87 outside IC area

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	7.9	Mean	25.94
Maximum	65	Median	16
SD	20.58	Std. Error of Mean	7.777
Coefficient of Variation	0.793	Skewness	1.319

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.855	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.257	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	41.06	95% Adjusted-CLT UCL (Chen-1995)	42.88
		95% Modified-t UCL (Johnson-1978)	41.7
Gamma GOF Test			
A-D Test Statistic	0.319	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.231	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.315	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.114	k star (bias corrected MLE)	1.303
Theta hat (MLE)	12.27	Theta star (bias corrected MLE)	19.91
nu hat (MLE)	29.6	nu star (bias corrected)	18.24
MLE Mean (bias corrected)	25.94	MLE Sd (bias corrected)	22.73
		Approximate Chi Square Value (0.05)	9.568
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	7.746

	A–E	F	G–K	L
52				
53	**Assuming Gamma Distribution**			
54	95% Approximate Gamma UCL (use when n>=50))	49.47	95% Adjusted Gamma UCL (use when n<50)	61.1
55				
56	**Lognormal GOF Test**			
57	Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk Lognormal GOF Test**	
58	5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
59	Lilliefors Test Statistic	0.189	**Lilliefors Lognormal GOF Test**	
60	5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	
61	**Data appear Lognormal at 5% Significance Level**			
62				
63	**Lognormal Statistics**			
64	Minimum of Logged Data	2.067	Mean of logged Data	3.001
65	Maximum of Logged Data	4.174	SD of logged Data	0.764
66				
67	**Assuming Lognormal Distribution**			
68	95% H-UCL	70	90% Chebyshev (MVUE) UCL	48
69	95% Chebyshev (MVUE) UCL	58.13	97.5% Chebyshev (MVUE) UCL	72.19
70	99% Chebyshev (MVUE) UCL	99.8		
71				
72	**Nonparametric Distribution Free UCL Statistics**			
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**			
74				
75	**Nonparametric Distribution Free UCLs**			
76	95% CLT UCL	38.74	95% Jackknife UCL	41.06
77	95% Standard Bootstrap UCL	37.71	95% Bootstrap-t UCL	47.58
78	95% Hall's Bootstrap UCL	48.12	95% Percentile Bootstrap UCL	39.09
79	95% BCA Bootstrap UCL	42.8		
80	90% Chebyshev(Mean, Sd) UCL	49.28	95% Chebyshev(Mean, Sd) UCL	59.84
81	97.5% Chebyshev(Mean, Sd) UCL	74.51	99% Chebyshev(Mean, Sd) UCL	103.3
82				
83	**Suggested UCL to Use**			
84	95% Student's-t UCL	41.06		
85				
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
87	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
88	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
89	For additional insight the user may want to consult a statistician.			
90				
91				
92	**Site 87 within IC area**			
93				
94	**General Statistics**			
95	Total Number of Observations	128	Number of Distinct Observations	113
96			Number of Missing Observations	2
97	Minimum	4.8	Mean	166.5
98	Maximum	939.6	Median	46.8
99	SD	228.1	Std. Error of Mean	20.16
100	Coefficient of Variation	1.37	Skewness	1.579
101				
102	**Normal GOF Test**			

	A–E	F	G–K	L
103	Shapiro Wilk Test Statistic	0.716	**Shapiro Wilk GOF Test**	
104	5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
105	Lilliefors Test Statistic	0.265	**Lilliefors GOF Test**	
106	5% Lilliefors Critical Value	0.0783	Data Not Normal at 5% Significance Level	
107	**Data Not Normal at 5% Significance Level**			
108				
109	**Assuming Normal Distribution**			
110	**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**	
111	95% Student's-t UCL	200	95% Adjusted-CLT UCL (Chen-1995)	202.7
112			95% Modified-t UCL (Johnson-1978)	200.4
113				
114	**Gamma GOF Test**			
115	A-D Test Statistic	4.772	**Anderson-Darling Gamma GOF Test**	
116	5% A-D Critical Value	0.812	Data Not Gamma Distributed at 5% Significance Level	
117	K-S Test Statistic	0.16	**Kolmogrov-Smirnoff Gamma GOF Test**	
118	5% K-S Critical Value	0.0865	Data Not Gamma Distributed at 5% Significance Level	
119	**Data Not Gamma Distributed at 5% Significance Level**			
120				
121	**Gamma Statistics**			
122	k hat (MLE)	0.576	k star (bias corrected MLE)	0.568
123	Theta hat (MLE)	289	Theta star (bias corrected MLE)	293.3
124	nu hat (MLE)	147.5	nu star (bias corrected)	145.4
125	MLE Mean (bias corrected)	166.5	MLE Sd (bias corrected)	221
126			Approximate Chi Square Value (0.05)	118.5
127	Adjusted Level of Significance	0.0481	Adjusted Chi Square Value	118.2
128				
129	**Assuming Gamma Distribution**			
130	95% Approximate Gamma UCL (use when n>=50))	204.3	95% Adjusted Gamma UCL (use when n<50)	204.8
131				
132	**Lognormal GOF Test**			
133	Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk Lognormal GOF Test**	
134	5% Shapiro Wilk P Value	2.721E-11	Data Not Lognormal at 5% Significance Level	
135	Lilliefors Test Statistic	0.11	**Lilliefors Lognormal GOF Test**	
136	5% Lilliefors Critical Value	0.0783	Data Not Lognormal at 5% Significance Level	
137	**Data Not Lognormal at 5% Significance Level**			
138				
139	**Lognormal Statistics**			
140	Minimum of Logged Data	1.569	Mean of logged Data	4.037
141	Maximum of Logged Data	6.845	SD of logged Data	1.569
142				
143	**Assuming Lognormal Distribution**			
144	95% H-UCL	284.9	90% Chebyshev (MVUE) UCL	302.8
145	95% Chebyshev (MVUE) UCL	353.9	97.5% Chebyshev (MVUE) UCL	424.9
146	99% Chebyshev (MVUE) UCL	564.4		
147				
148	**Nonparametric Distribution Free UCL Statistics**			
149	**Data do not follow a Discernible Distribution (0.05)**			
150				
151	**Nonparametric Distribution Free UCLs**			
152	95% CLT UCL	199.7	95% Jackknife UCL	200
153	95% Standard Bootstrap UCL	200.4	95% Bootstrap-t UCL	203.4

	A	B	C	D	E	F	G	H	I	J	K	L
154					95% Hall's Bootstrap UCL	202.6					95% Percentile Bootstrap UCL	201.6
155					95% BCA Bootstrap UCL	201.4						
156					90% Chebyshev(Mean, Sd) UCL	227					95% Chebyshev(Mean, Sd) UCL	254.4
157					97.5% Chebyshev(Mean, Sd) UCL	292.5					99% Chebyshev(Mean, Sd) UCL	367.2
158												
159						Suggested UCL to Use						
160					95% Chebyshev (Mean, Sd) UCL	254.4						
161												
162	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
163	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
164	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
165	For additional insight the user may want to consult a statistician.											
166												

LEAD RISK ASSESSMENT SPREADSHEET 8
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Click here for ABBREVIATED INSTRUCTIONS FOR LEADSPREAD 8

INPUT	
MEDIUM	LEVEL
Lead in Soil/Dust (ug/g)	254.4
Respirable Dust (ug/m^3)	1.5

OUTPUT					
Percentile Estimate of Blood Pb (ug/dl)					
	50th	90th	95th	98th	99th
BLOOD Pb, CHILD	1.8	3.3	3.9	4.7	5.4
BLOOD Pb, PICA CHILD	3.6	6.6	7.8	9.4	10.8

EXPOSURE PARAMETERS		
	units	children
Days per week	days/wk	7
Geometric Standard Deviation		1.6
Blood lead level of concern (ug/dl)		1
Skin area, residential	cm^2	2900
Soil adherence	ug/cm^2	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001
Soil ingestion	mg/day	100
Soil ingestion, pica	mg/day	200
Ingestion constant	(ug/dl)/(ug/day)	0.16
Bioavailability	unitless	0.44
Breathing rate	m^3/day	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.192

PATHWAYS						
CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.8E-5	0.01	1%		0.01	0%
Soil Ingestion	7.0E-3	1.79	99%	1.4E-2	3.58	100%
Inhalation	2.0E-6	0.00	0%		0.00	0%

Click here for REFERENCES

LEAD RISK ASSESSMENT SPREADSHEET 8

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Click here for ABBREVIATED INSTRUCTIONS FOR LEADSPREAD 8

INPUT	
MEDIUM	LEVEL
Lead in Soil/Dust (ug/g)	41.1
Respirable Dust (ug/m^3)	1.5

OUTPUT					
Percentile Estimate of Blood Pb (ug/dl)					
	50th	90th	95th	98th	99th
BLOOD Pb, CHILD	0.3	0.5	0.6	0.8	0.9
BLOOD Pb, PICA CHILD	0.6	1.1	1.3	1.5	1.7

EXPOSURE PARAMETERS		
	units	children
Days per week	days/wk	7
Geometric Standard Deviation		1.6
Blood lead level of concern (ug/dl)		1
Skin area, residential	cm^2	2900
Soil adherence	ug/cm^2	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001
Soil ingestion	mg/day	100
Soil ingestion, pica	mg/day	200
Ingestion constant	(ug/dl)/(ug/day)	0.16
Bioavailability	unitless	0.44
Breathing rate	m^3/day	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.192

PATHWAYS						
CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.8E-5	0.00	1%		0.00	0%
Soil Ingestion	7.0E-3	0.29	99%	1.4E-2	0.58	100%
Inhalation	2.0E-6	0.00	0%		0.00	0%

Click here for REFERENCES

	A	B	C	D	E	F
1	Site 89 North no ICs	Site 89 South no ICs	Site 89 South ICs	Site 89 North bias	Site 89 South bias no IC	Site 89 South bias IC
2	36.5	15.8		16	20.1	
3	27.9	17.3		14.7	9.5	
4	18.2	17.1		11.2	7.8	
5	17.6	20.5			8.2	
6	24.1		16.3	7.9	14.1	
7	14.9		13.8	8.2	17.7	
8	33.5	11.4		13.1	19	
9	25.3	141		24.6	18.3	
10	24.3	13.9		23.8		8.2
11	21.8	5.4		12.4		9.3
12	20.7	35				6.5
13					10.1	
14	17.1			9		
15	20.8			10.6		14.7
16	79.7			62.1		15.7
17	39.5			24		
18	62.7			14.8		
19	20			26.9	70.9	
20	149			39.2	87.8	
21	19.5			31.6	14.7	
22	39.4			47.5		36.7
23				53.6		11.6
24	89.4			26.9		15.3
25	141.5			70.7		
26				39.5		
27	9.9			29.4		
28				20		
29	39.8			14.3		
30	70.2			13.3		
31	31			16.7		
32	98.4			14.5		
33	54.8			96.3		
34	11.7					
35	35.4					
36	40.4			63.5		
37						
38	38.2					
39	14.8					
40	16.2			17		
41	10.1			16.5		
42						
43	34.2					
44	36.9					
45	17.9					

	A	B	C	D	E	F
46	96.4					
47	18.5					
48	10.2					
49	79.1					
50	88.2					
51	20					
52						
53	34.2					
54						
55						
56	54.3					
57	21					
58	17.7					
59	16.8					
60	11					
61	96.1					

Row				
1	**UCL Statistics for Uncensored Full Data Sets**			
2				
3	User Selected Options			
4	Date/Time of Computation	4/1/2015 2:50:52 PM		
5	From File	WorkSheet.xls		
6	Full Precision	OFF		
7	Confidence Coefficient	95%		
8	Number of Bootstrap Operations	2000		
9				
10				
11	**Lead ppm 89 North no ICs**			
12				
13	**General Statistics**			
14	Total Number of Observations	56	Number of Distinct Observations	52
15			Number of Missing Observations	10
16	Minimum	9.9	Mean	38.37
17	Maximum	149	Median	24.8
18	SD	32.45	Std. Error of Mean	4.336
19	Coefficient of Variation	0.846	Skewness	1.756
20				
21	**Normal GOF Test**			
22	Shapiro Wilk Test Statistic	0.772	**Shapiro Wilk GOF Test**	
23	5% Shapiro Wilk P Value	3.192E-11	Data Not Normal at 5% Significance Level	
24	Lilliefors Test Statistic	0.243	**Lilliefors GOF Test**	
25	5% Lilliefors Critical Value	0.118	Data Not Normal at 5% Significance Level	
26	**Data Not Normal at 5% Significance Level**			
27				
28	**Assuming Normal Distribution**			
29	**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**	
30	95% Student's-t UCL	45.63	95% Adjusted-CLT UCL (Chen-1995)	46.59
31			95% Modified-t UCL (Johnson-1978)	45.8
32				
33	**Gamma GOF Test**			
34	A-D Test Statistic	1.804	**Anderson-Darling Gamma GOF Test**	
35	5% A-D Critical Value	0.763	Data Not Gamma Distributed at 5% Significance Level	
36	K-S Test Statistic	0.146	**Kolmogrov-Smirnoff Gamma GOF Test**	
37	5% K-S Critical Value	0.12	Data Not Gamma Distributed at 5% Significance Level	
38	**Data Not Gamma Distributed at 5% Significance Level**			
39				
40	**Gamma Statistics**			
41	k hat (MLE)	1.952	k star (bias corrected MLE)	1.86
42	Theta hat (MLE)	19.65	Theta star (bias corrected MLE)	20.63
43	nu hat (MLE)	218.7	nu star (bias corrected)	208.3
44	MLE Mean (bias corrected)	38.37	MLE Sd (bias corrected)	28.14
45			Approximate Chi Square Value (0.05)	175.9
46	Adjusted Level of Significance	0.0457	Adjusted Chi Square Value	175.1
47				
48	**Assuming Gamma Distribution**			
49	95% Approximate Gamma UCL (use when n>=50))	45.44	95% Adjusted Gamma UCL (use when n<50)	45.64
50				
51	**Lognormal GOF Test**			

	A	B	C	D	E	F	G	H	I	J	K	L
52					Shapiro Wilk Test Statistic	0.936			**Shapiro Wilk Lognormal GOF Test**			
53					5% Shapiro Wilk P Value	0.00717			Data Not Lognormal at 5% Significance Level			
54					Lilliefors Test Statistic	0.12			**Lilliefors Lognormal GOF Test**			
55					5% Lilliefors Critical Value	0.118			Data Not Lognormal at 5% Significance Level			
56							**Data Not Lognormal at 5% Significance Level**					
57												
58							**Lognormal Statistics**					
59					Minimum of Logged Data	2.293					Mean of logged Data	3.37
60					Maximum of Logged Data	5.004					SD of logged Data	0.723
61												
62							**Assuming Lognormal Distribution**					
63					95% H-UCL	46.16					90% Chebyshev (MVUE) UCL	49.56
64					95% Chebyshev (MVUE) UCL	55					97.5% Chebyshev (MVUE) UCL	62.55
65					99% Chebyshev (MVUE) UCL	77.38						
66												
67							**Nonparametric Distribution Free UCL Statistics**					
68							**Data do not follow a Discernible Distribution (0.05)**					
69												
70							**Nonparametric Distribution Free UCLs**					
71					95% CLT UCL	45.51					95% Jackknife UCL	45.63
72					95% Standard Bootstrap UCL	45.53					95% Bootstrap-t UCL	47.21
73					95% Hall's Bootstrap UCL	46.85					95% Percentile Bootstrap UCL	45.8
74					95% BCA Bootstrap UCL	46.61						
75					90% Chebyshev(Mean, Sd) UCL	51.38					95% Chebyshev(Mean, Sd) UCL	57.27
76					97.5% Chebyshev(Mean, Sd) UCL	65.45					99% Chebyshev(Mean, Sd) UCL	81.52
77												
78							**Suggested UCL to Use**					
79					95% Chebyshev (Mean, Sd) UCL	57.27						
80												
81							Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.					
82							These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)					
83							and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.					
84							For additional insight the user may want to consult a statistician.					
85												
86												
87	**Site 89 South no ICs**											
88												
89							**General Statistics**					
90					Total Number of Observations	12					Number of Distinct Observations	12
91											Number of Missing Observations	3
92					Minimum	5.4					Mean	25.73
93					Maximum	141					Median	14.85
94					SD	37.06					Std. Error of Mean	10.7
95					Coefficient of Variation	1.441					Skewness	3.229
96												
97							**Normal GOF Test**					
98					Shapiro Wilk Test Statistic	0.496			**Shapiro Wilk GOF Test**			
99					5% Shapiro Wilk Critical Value	0.859			Data Not Normal at 5% Significance Level			
100					Lilliefors Test Statistic	0.389			**Lilliefors GOF Test**			
101					5% Lilliefors Critical Value	0.256			Data Not Normal at 5% Significance Level			
102							**Data Not Normal at 5% Significance Level**					

	A	B	C	D	E	F	G	H	I	J	K	L
103												
104	**Assuming Normal Distribution**											
105	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
106					95% Student's-t UCL	44.94					95% Adjusted-CLT UCL (Chen-1995)	53.98
107											95% Modified-t UCL (Johnson-1978)	46.6
108												
109	**Gamma GOF Test**											
110					A-D Test Statistic	1.422	**Anderson-Darling Gamma GOF Test**					
111					5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level					
112					K-S Test Statistic	0.312	**Kolmogrov-Smirnoff Gamma GOF Test**					
113					5% K-S Critical Value	0.251	Data Not Gamma Distributed at 5% Significance Level					
114	**Data Not Gamma Distributed at 5% Significance Level**											
115												
116	**Gamma Statistics**											
117					k hat (MLE)	1.292					k star (bias corrected MLE)	1.025
118					Theta hat (MLE)	19.91					Theta star (bias corrected MLE)	25.1
119					nu hat (MLE)	31.01					nu star (bias corrected)	24.59
120					MLE Mean (bias corrected)	25.73					MLE Sd (bias corrected)	25.41
121											Approximate Chi Square Value (0.05)	14.3
122					Adjusted Level of Significance	0.029					Adjusted Chi Square Value	13.12
123												
124	**Assuming Gamma Distribution**											
125					95% Approximate Gamma UCL (use when n>=50))	44.24					95% Adjusted Gamma UCL (use when n<50)	48.24
126												
127	**Lognormal GOF Test**											
128					Shapiro Wilk Test Statistic	0.846	**Shapiro Wilk Lognormal GOF Test**					
129					5% Shapiro Wilk Critical Value	0.859	Data Not Lognormal at 5% Significance Level					
130					Lilliefors Test Statistic	0.233	**Lilliefors Lognormal GOF Test**					
131					5% Lilliefors Critical Value	0.256	Data appear Lognormal at 5% Significance Level					
132	**Data appear Approximate Lognormal at 5% Significance Level**											
133												
134	**Lognormal Statistics**											
135					Minimum of Logged Data	1.686					Mean of logged Data	2.813
136					Maximum of Logged Data	4.949					SD of logged Data	0.813
137												
138	**Assuming Lognormal Distribution**											
139					95% H-UCL	43.79					90% Chebyshev (MVUE) UCL	39.03
140					95% Chebyshev (MVUE) UCL	46.56					97.5% Chebyshev (MVUE) UCL	57
141					99% Chebyshev (MVUE) UCL	77.53						
142												
143	**Nonparametric Distribution Free UCL Statistics**											
144	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
145												
146	**Nonparametric Distribution Free UCLs**											
147					95% CLT UCL	43.32					95% Jackknife UCL	44.94
148					95% Standard Bootstrap UCL	43.08					95% Bootstrap-t UCL	140.2
149					95% Hall's Bootstrap UCL	131.6					95% Percentile Bootstrap UCL	45.38
150					95% BCA Bootstrap UCL	57.28						
151					90% Chebyshev(Mean, Sd) UCL	57.82					95% Chebyshev(Mean, Sd) UCL	72.36
152					97.5% Chebyshev(Mean, Sd) UCL	92.53					99% Chebyshev(Mean, Sd) UCL	132.2
153												

	A	B	C	D	E	F	G	H	I	J	K	L
154	Suggested UCL to Use											
155	95% Chebyshev (Mean, Sd) UCL					72.36						
156												
157	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
158	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
159	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
160	For additional insight the user may want to consult a statistician.											
161												
162												
163	Site 89 South ICs											
164												
165	General Statistics											
166	Total Number of Observations					2	Number of Distinct Observations					2
167							Number of Missing Observations					5
168	Minimum					13.8	Mean					15.05
169	Maximum					16.3	Median					15.05
170												
171	Warning: This data set only has 2 observations!											
172	Data set is too small to compute reliable and meaningful statistics and estimates!											
173	The data set for variable Site 89 South ICs was not processed!											
174												
175	It is suggested to collect at least 8 to 10 observations before using these statistical methods!											
176	If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.											
177												
178												

LEAD RISK ASSESSMENT SPREADSHEET 8

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Click here for ABBREVIATED INSTRUCTIONS FOR LEADSPREAD 8

INPUT	
MEDIUM	LEVEL
Lead in Soil/Dust (ug/g)	57.3
Respirable Dust (ug/m^3)	1.5

OUTPUT					
Percentile Estimate of Blood Pb (ug/dl)					
	50th	90th	95th	98th	99th
BLOOD Pb, CHILD	0.4	0.7	0.9	1.1	1.2
BLOOD Pb, PICA CHILD	0.8	1.5	1.8	2.1	2.4

EXPOSURE PARAMETERS		
	units	children
Days per week	days/wk	7
Geometric Standard Deviation		1.6
Blood lead level of concern (ug/dl)		1
Skin area, residential	cm^2	2900
Soil adherence	ug/cm^2	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001
Soil ingestion	mg/day	100
Soil ingestion, pica	mg/day	200
Ingestion constant	(ug/dl)/(ug/day)	0.16
Bioavailability	unitless	0.44
Breathing rate	m^3/day	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.192

PATHWAYS						
CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.8E-5	0.00	1%		0.00	0%
Soil Ingestion	7.0E-3	0.40	99%	1.4E-2	0.81	100%
Inhalation	2.0E-6	0.00	0%		0.00	0%

Click here for REFERENCES

LEAD RISK ASSESSMENT SPREADSHEET 8
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Click here for ABBREVIATED INSTRUCTIONS FOR LEADSPREAD 8

INPUT	
MEDIUM	LEVEL
Lead in Soil/Dust (ug/g)	72.4
Respirable Dust (ug/m^3)	1.5

OUTPUT					
	Percentile Estimate of Blood Pb (ug/dl)				
	50th	90th	95th	98th	99th
BLOOD Pb, CHILD	0.5	0.9	1.1	1.3	1.5
BLOOD Pb, PICA CHILD	1.0	1.9	2.2	2.7	3.1

EXPOSURE PARAMETERS		
	units	children
Days per week	days/wk	7
Geometric Standard Deviation		1.6
Blood lead level of concern (ug/dl)		1
Skin area, residential	cm^2	2900
Soil adherence	ug/cm^2	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001
Soil ingestion	mg/day	100
Soil ingestion, pica	mg/day	200
Ingestion constant	(ug/dl)/(ug/day)	0.16
Bioavailability	unitless	0.44
Breathing rate	m^3/day	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.192

PATHWAYS						
CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.8E-5	0.00	1%		0.00	0%
Soil Ingestion	7.0E-3	0.51	99%	1.4E-2	1.02	100%
Inhalation	2.0E-6	0.00	0%		0.00	0%

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FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE